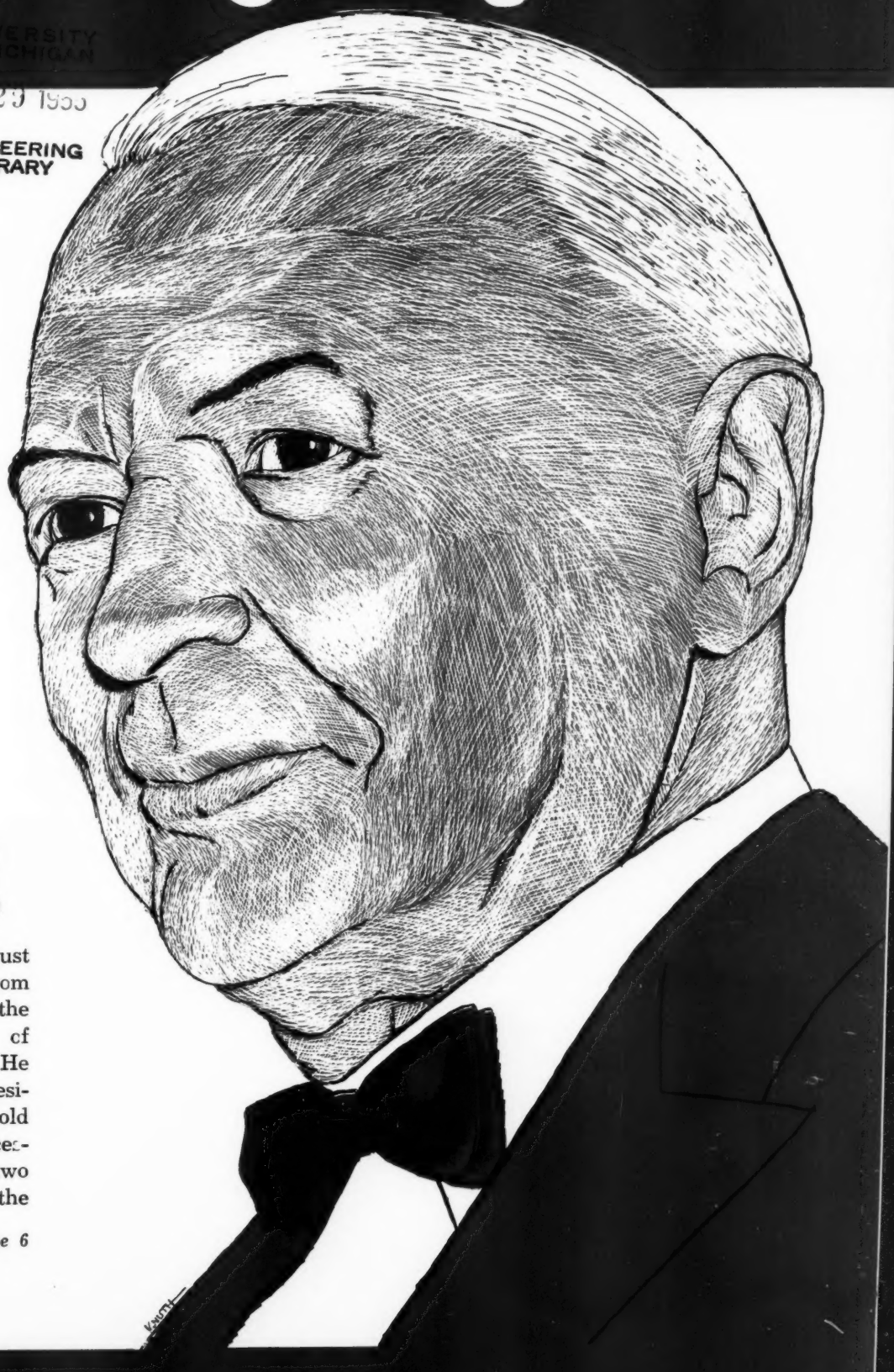
consulting engineer

March 1955

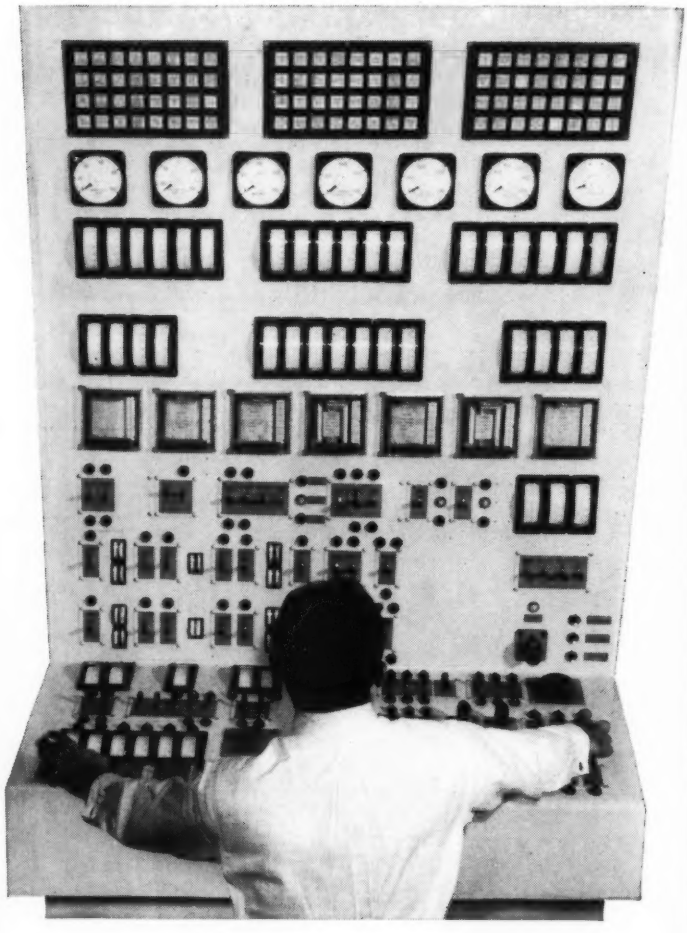


Enlightened Conservative

SCOTT TURNER just stepped down from the presidency of the American Institute of Consulting Engineers. He was the only AICE president in 30 years to hold this office for two successive terms. In these two terms, Turner saw the

—Continued on page 6

The Consulting Engineer's Professional Magazine



NEW DIMENSIONS in boiler plant instrumentation

Controlling a giant boiler, turbine, and generator from a panel 4 feet wide!

At Ninemile Point Plant of the Louisiana Power and Light Company, the new third unit is controlled by the unusually compact B.T.G. control panel shown here. The B.T.G. (Boiler-Turbine-Generator) panel built by Hays is an innovation of Ebasco Services, Incorporated.

Practically every detail of the third unit of Louisiana Power's new Ninemile Point generating plant is of the newest design. An all-weather outdoor boiler with Hays electric type combustion control—gas fired, with provisions for "stand-by" oil firing—will produce over 1,000,000 lbs. of steam per hour, superheated and reheated to 1,005°F.

On outdoor boilers electrically operated combustion control is especially preferred because it doesn't require expensive compressors and dryers, allows maximum freedom in control room location. For greater speed of response and accuracy new Hays electronic instruments, including electronic mercury-less flowmeters and 3 element electronic feed water control are being installed.

Among the central stations recently selecting Hays instrumentation and control are: Jersey Central Power and Light Co., Northern Indiana Public Service Co., Central Illinois Electric and Gas Co., St. Joseph Power and Light Co., Crawfordsville Power and Light Co.

Write for Hays Boiler Plant Instrumentation Bulletin 54-605-83.

THE **hays** CORPORATION

MICHIGAN CITY 32, INDIANA

Automatic Combustion Control · Veriflow Meters and Veritrol · Electronic Oxygen Recorders · CO-Recorders Boiler Panels · Gas Analyzers · Combustion Test Sets Draft Gages · Electronic Flowmeters · Miniature Remote Indicators · Electronic Feed Water Controls

VOLUME 5

NUMBER 3

Published by Industry and Power Publications
420 Main Street, St. Joseph, Mich.

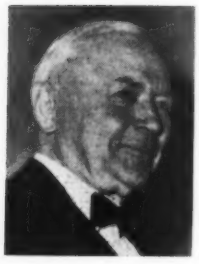
consulting engineer®

MARCH 1955

FEATURES

DEPARTMENTS

NBP CONSULTING ENGINEER is published monthly at 420 Main St., St. Joseph, Mich. Subscription 1 year $5.00; outside U. S. price $10.00; single copy 50c. Accepted as Controlled Circulation Publication at Saint Joseph, Michigan. Send Form 3579 to Saint Joseph, Mich. BPA Copyright 1955 Industry and Power Publishing Company.

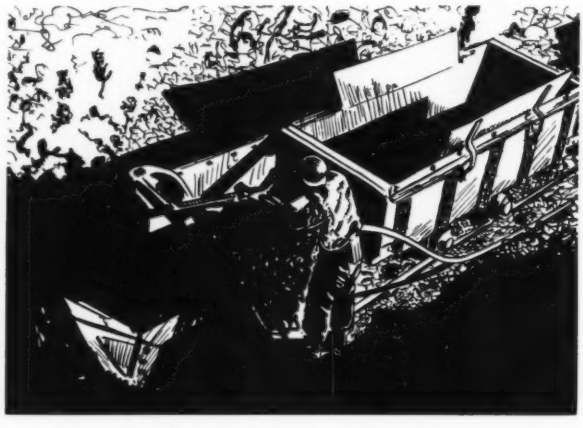


Enlightened Conservative

—Starts on front cover

AICE's membership grow over 20 percent. But he quickly points out that the AICE is small by comparison with other engineering societies. It is a conservative group, with no bureaucratic ambitions to gather in all engineers who may be in consulting practice. There is no inclination to set up the AICE in competition with existing technical societies.

Though Turner subscribes to the rather conservative policies of the AICE, the whole of engineering has been affected by his work. He has been one of the principal driving forces behind formulation and adoption of the Canons of Ethics, from its conception in 1939. (Today, The Canons have been adopted by some 85 engineering organizations.) Turner thinks, in the light of long experience with The Canons, that perhaps they might have been more aptly given a slightly different title — such as "accepted rules (or principles) of practice."



After all, the word "ethics" suggests to many people the moral principles that most tots begin to learn at their mother's knee, rather than the rules of conduct adopted by some engineering institute. Ethics are the manifestations of one's conscience and religious training. Admittedly, "accepted rules of conduct" are an embodiment of ethical standards. But the fundamental concepts of ethics that underlie acceptable codes of practice are something Turner believes are instilled long before an engineer gets to school.

Mistakes So Permanent

Turner notices that those consultants who have maintained a successful practice over a long period of time generally gravitate to the top simply because their professional conduct and technical proficiency have been proved beyond challenge. Those whose conduct and proficiency are subject to reasonable challenge do not fare so well. The record of a successful engineer has to be good, because the results of his mistakes are "so permanent." The engineer's errors cannot be hidden in scientific jargon, nor can they be obscured by shrubbery, nor can they be erased by introduction of a superseding model.

Without condoning them, Turner displays a rare understanding of the underlying reasons for the enactment of some laws that compel governmental bodies to award engineering contracts only after public call for bids. "My toes don't curl at the mere mention of competitive bidding, because some of the laws requiring it, especially in the case of the Federal government, may have been based on previous, demonstrated need. We must not give the idea that we condemn all laws calling for competitive bidding. But, in the case of the professional services of the consulting engineer, we are all agreed that such a method of award is hostile to the ethics of our profession, opposed to the rules of many of our engineering societies, and contrary to the public interest."

Turner points out that the average taxpayer is unaware of the niceties of the higher echelons of professional engineering. To such a taxpayer, Turner asks, which looks like better handling of his funds: open bidding with the award going to the consultant offering his professional services at the lowest price, or the award of work based on closed-door negotiations with a few pre-selected firms?

He points out that presently existing laws calling for bidding represent the cumulative experience of past generations, and were enacted from time to time to correct evils as they became apparent. Perhaps Turner better understands the taxpayer's side of the question than do many critics of bidding. He acknowledges, "Public funds have to be administered as publicly as possible, if the average taxpayer is to feel satisfied."

Positive Leadership

A complete biography of Turner's affiliations, honors, and accomplishments represents a monumental chore. By way of example, he has served as director of the U. S. Bureau of Mines, is a past president of the AIME, and has served on many state, federal and international boards and commissions. He has exerted positive leadership in such engineering organizations as AIME, AICE, CIM I, ECPD, EJC, and others. He has been in active practice of mining engineering for 53 years. Now an alert 75 years old, Turner demonstrates that an engineer can serve the public and his profession while maintaining technical proficiency—and can do an outstanding job on all fronts. ▲

The C-E La Mont Controlled Circulation Hot Water Boiler

for large heating and process applications

Combustion's high-temperature (H-T) water boiler is especially designed to utilize the inherent advantages of hot water over steam (see opposite page) for large central heating installations and for many process applications. Units are available in sizes from 10,000,000 Btu per hour up, for any fuel, with pressures up to 300 psi and water temperatures to about 425 F. The chief advantages of the C-E La MONT *Controlled Circulation* Hot Water Boiler are:

Complete control — System control over the H-T water movement is extended to the boiler at all heat rates, since the water is under positive, controlled pressure.

Low pressure loss — Because of the low pressure loss inherent in the design, the system circulating pumps can be used to provide circulation through the boiler.

Pressurized operation — Used with oil or gas fired boilers, pressurized operation permits a simple stack arrangement and eliminates the need for induced draft fans.

Single-pass design — Absence of baffles not only assures low draft loss but also a cleaner boiler since there are no dead areas where deposits are likely to accumulate.

High furnace heat rates — The close spacing of furnace wall tubes offers greater wall protection, permits high heat rates in the furnace with low maintenance.

More efficient heat transfer — Since the water is positively circulated through the heating circuits, these circuits may be proportioned and arranged for maximum efficiency.

Lighter boiler weight — Less surface is needed because heating surfaces are more efficient. With closely spaced wall tubes, setting thickness is reduced.

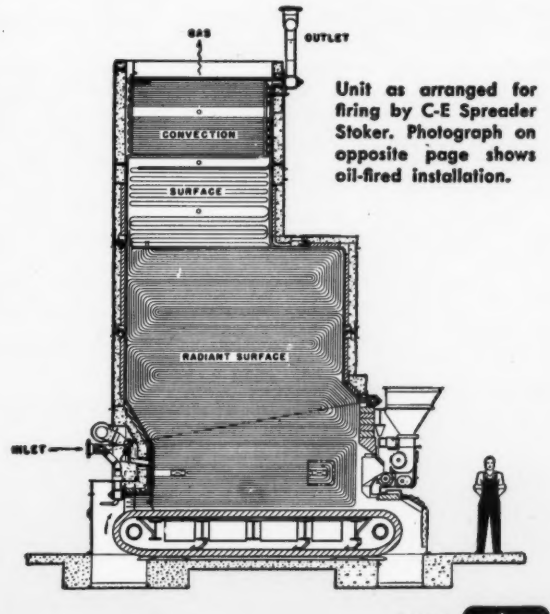
Any fuel — Boilers can be arranged for oil or gas burners, or spreader stokers. Special designs using other types of firing or waste heat are also available.

Other design features — All boiler tubes are completely drainable and ventable—small number of headers all accessible from outside of casing — completely steel-enclosed setting.

If you have a heating or process job that's suitable for high-temperature water, it will pay you to look into a C-E La Mont installation. As compared to steam, it will give you a simpler and less expensive distribution system and lower fuel and maintenance costs, plus the specific advantages described at left. Write for further information.

TYPICAL APPLICATIONS OF H-T WATER

Space Heating	Heating Platens
Ovens	Hot Tables
Tanks	Snow Melting Coils
Kettles	Cafeteria and
Calendar Rolls	Kitchen Apparatus



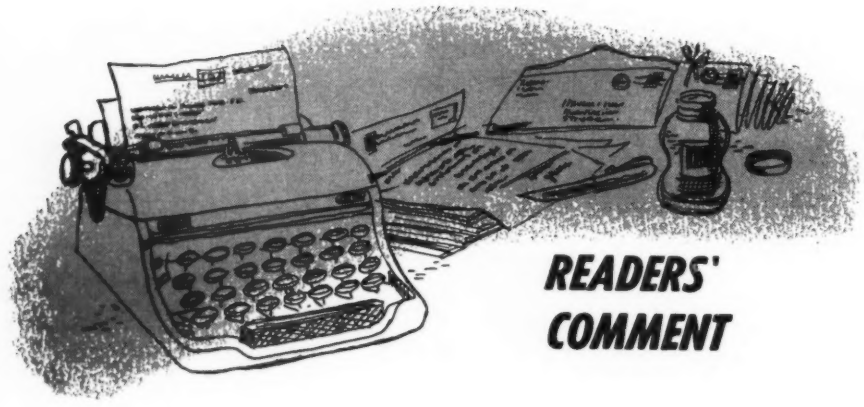
Unit as arranged for firing by C-E Spreader Stoker. Photograph on opposite page shows oil-fired installation.

B-806C

COMBUSTION ENGINEERING

Combustion Engineering Building • 200 Madison Avenue, New York 16, N. Y.

BOILERS; FUEL BURNING & RELATED EQUIPMENT; PULVERIZERS, AIR SEPARATORS & FLASH DRYING SYSTEMS; PRESSURE VESSELS; AUTOMATIC WATER HEATERS; SOIL PIPE



READERS' COMMENT

'Tis an old maxin in the schools,
That flattery's the food of fools;
Yet now and then your men of wit
Will condescend to take a bit.
Swift

I enjoy the magazine a lot and it helps us keep up with new ideas and new equipment.

George H. Stain
McCoy Engineering
Charleston, West Virginia

Many favorable comments are made about your magazine. You have caught the true spirit of professionalism, and of the Engineer's needs and problems, in the writer's opinion.

W. J. Roa, Jr.
Sr. Electrical Engineer
Sverdrup & Parcel, Inc.
St. Louis, Missouri

I particularly like this magazine because it covers the field of administration in lieu of the technical aspects of engineering.

John C. Ross
John D. Falvey, Cons. Engr.
St. Louis, Missouri

Congratulations on your January 1955 issue. It was the best ever.

R. L. Eason, Consulting Engineer
R. L. Eason & Associates
St. Louis, Missouri

Congratulations on a job well done.

Would like to see a discussion on Consulting Engineering fees in regard to working with architects, including amount of supervision and method of payment.

G. B. Linn, P. E., Asst. Engr.
Vincent Eaton, Consulting Engineers
Cleveland, Ohio

• ARTICLE ON THIS SUBJECT IS ON OUR SCHEDULE.

The copy of CONSULTING ENGINEER that I receive is circulated among the staff of our Boston office. We agree that it is well worth reading. We appreciate your sending it to us.

Joseph W. Lavin, Associate
Edwards, Kelcey & Beck
Boston, Massachusetts

Your recent articles, commenting on the actual professional status of the engineer in the U. S. and on the facts about E.S.A. are extremely refreshing in the frankness and honesty they exhibit. They are timely and needed. Its a great service to help us to face, instead of evade, these issues.

Arthur G. McKee & Co.
Cleveland, Ohio

In your January, 1955 issue of CONSULTING ENGINEER you reported on a questionnaire survey of consulting engineers, stating that only 5.1 percent of those canvassed are members of this Institute. You and your Magazine also commented that the American Institute of Consulting Engineers is primarily a New York organization and can hardly be called a national organization....

I have just checked our membership roster and find that 57 percent of our members are not in the New York area and have non-resident membership status.

Francis S. Friel, President
American Institute of Consulting Engineers
New York 18, New York

• AICE HAS A TOTAL MEMBERSHIP OF ABOUT 250. SINCE MEMBERS FROM OUTSIDE NEW YORK CITY ARE LABELED "NON-RESIDENT," WE FEEL AICE "CAN HARDLY BE CALLED A NATIONAL ORGANIZATION."

I should like to offer my congratulations on January issue of CONSULTING ENGINEER. I think it an exceptionally fine one, containing many articles of value.

C. R. Barthelemy
Chief Mechanical Engineer
Pioneer Service & Engineering Co.
Chicago, Illinois

I have received the January issue of CONSULTING ENGINEER and am very much pleased with the presentation of my paper on "Canons of Ethics for Engineers." I thought also that the reprint of the Canons was particularly well done.

I have had occasion before to compliment you on the courageous manner in which you attack certain basic problems in the engineering profession. I feel that your "Survey of the Profession" in the January issue is a most constructive tabulation. The article is splendidly amplified by the Staff Report "You've Got to be a Joiner!"

W. F. Ryan, Vice President
Stone & Webster Engineering Corp.
Boston, Massachusetts

• COPIES OF THE CANONS ON PARCHMENT PAPER 12 x 14 IN., ARE AVAILABLE AT 25¢ EACH. WRITE CONSULTING ENGINEER, 420 MAIN ST., ST. JOSEPH, MICHIGAN.

Road Man Reaction

Regarding the letters of Messers M. von Ch. Barraza and Al Seskin in the Dec. and Jan. issues . . . I am certain these gentlemen must have written with tongue in cheek, but I shall continue as though they were serious since that is the viewpoint taken by the younger members of the profession upon reading this stuff.

First, I don't think either one of these gentlemen got the point of Mr. Lasky's article—or perhaps I misunderstood. I feel that he was concerned with what is known in the profession as the "alley-shop." These constitute a very, very small minority of the engineering "job-shops." Are Messers M. von Ch. Barraza and Al Seskin sheep that they permit a nasty old project manager or "floor-boss"—and I have been both in the past—to herd them into those smelly drafting rooms?

Second. All joking aside . . . there are, admittedly, a few "alley-shops" —large and small. I personally know of but one, the owner of which has more Bench Warrants outstanding against him than A. Hitler. Mr. Barraza's complaint of "less than 10 percent profit" is peculiar. Concerning engineering firms, there are two reservoirs of technical knowledge, (1) the Firm's library, the cost of which . . . can be amortized, and (2) the minds of the engineers working with him whose salaries are also expenses, so therefore his firm wants to make excessive profit charges simply because they are fortunate enough to have the specific type of man on their payroll — smacks of

"Employment Office" to me, or the "charge all the traffic will bear" technique.

Third. Evidently, Mr. Seskin learned nothing in his three years as a "victim." The type of man he would have become is what is known as a "road man" which is a very peculiar breed of cat. Until I took my present position I was listed as a road man, and happily so. In fact, I feel there should be a law requiring every graduate to spend at least 4 to 6 years on the road as a sort of "internship." There is nothing better to round out an engineer's practical education than a variety of jobs.

Fourth. Speaking in generalities, a large plant with a hot engineering job on the books cannot afford to hire the extra engineering staff, including the screening process, etc., and then lay them off in the next few months when the job is complete. By the way, Personnel Directors figure a cost of from $250.00 to $500.00 just to hire a new employee. So therefore, they contact the job-shops, who not only have the men available, but can supply them with work in another plant, another town, year after year—in Mr. Seskin's case, for three years, according to his letter.

Fifth. Certainly we got higher wages. Every few months we had to get used to another Project Engineer, new drafting room standards, new product, new system. Our families had to get used to a new town, the children to a new school—and we had to produce in every sense of the word or the reputation of our home office dropped, and consequently, we were out of work.

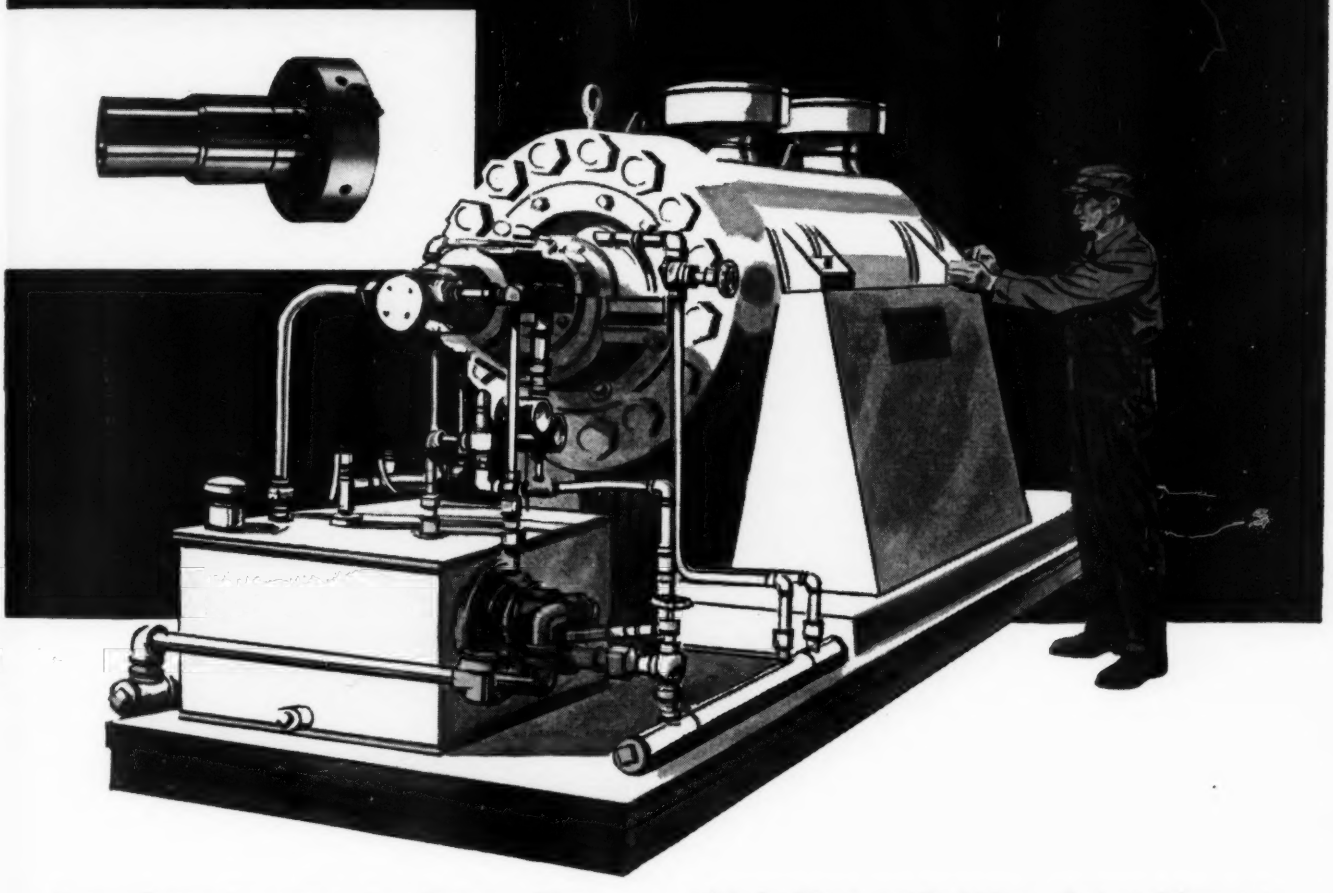
Sixth. As to the owners getting rich, I see that Mr. Seskin has not read Mr. Barraza's third paragraph closely nor has he had the opportunity to figure costs for one of these Employment Offices as I have. Basically, the composite room rate plus composite overhead rate plus a flat 10 percent profit mark-up determines the hourly rate charged the customer.

Seventh. The entire thing seems to me to be jealousy, or a tremendous amount of misinformation.

Eighth. To the editor, having been at one time or another, a member of both the AFL and the CIO in the dim past, may I comment that Unions and the M & M Associations are like defense work—when you need them, you need them, and when the emergency is over, drop them.

Robert H. Bigham
Bellflower, California

Now... BJ mechanical seals for high pressure boiler feed pumps!



Another Byron Jackson first!

- **No operating adjustment**
- **Stop liquid loss**
- **Reduce heat loss**
- **Save downtime costs**
- **Cut replacement costs**

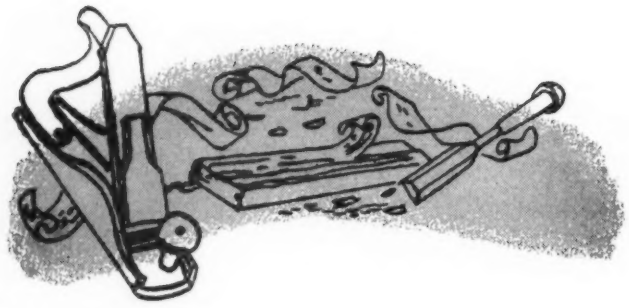
BJ. the pacemaker in mechanical seals for pumps . . . now has pioneered the first successful application of the mechanical seal to high pressure boiler feed pumps. These new BJ Mechanical Seals are now in operation in a number of high pressure, hot water pumping operations, including temperature up to 430° F. These seals—some in service as long as three years—have paid off in performance. They have minimized heat and liquid loss, eliminated frequent repacking problems, and simplified maintenance since no operating adjustment is required. Find out how these new BJ Mechanical Seals for boiler feed pump service can benefit you. Contact your nearby Byron Jackson office or write.

You'll do better with BJ

Byron Jackson Co.

Since 1872

P. O. BOX 2017, TERMINAL ANNEX, LOS ANGELES 54, CALIFORNIA



SCRAPS & SHAVINGS

ARE CHANGES NEEDED?

AT THE ANNUAL MEETING of the American Institute of Electrical Engineers, held last month in New York, Mr. T. M. Linville, of the General Electric Research Laboratories, presented a short paper on "Ethics and Statutes for the Engineering Profession." In speaking of the Canons* and the Model Law, Mr. Linville pointed out that they "do not fit together as neatly as engineers might expect them to." He goes on to say "that the difference is not one of actual disagreement as to what is right, but merely lack of completeness. . ."

With the first half of this statement we cannot agree. So far as we can see, there is no disagreement between the Canons and the Model Law. It is possible that they are incomplete. Any work of man is.

Mr. Linville's real point, and a good one, is that neither the Canons nor the Model Law take up the subject of group responsibility. That is, neither of these writings states whether it is ethical or legal for a corporation to practice engineering. This question has caused quite a commotion in New York State during the past couple of years. Under the New York Law only corporations that have been practicing engineering since 1935, are allowed to practice in the state. Naturally, corporate engineering firms without that 20 year's operating history consider this distinctly unfair.

The question of corporate practice has been answered in different ways in the statutes or in the courts of different states. There was a recent decision in the United States District Court for the District of Columbia, involving this point. The D.C. law is based almost directly on the Model Law. In his decision, the Judge stated that "manifestly only a natural person can come within the definition [of a professional engineer]." It may be implied from this that under a law based on the Model Law, only natural persons can practice engineering as a profession. Corporations are excluded.

We agree with Mr. Linville that this is a serious matter. But we feel that it involves the Model Law only theoretically and — the Canons of Ethics not at all. The Canons are a code of professional conduct, not a promulgation of prohibitive edicts. It would be very wrong for the Canons to include a statement as to whether a corporation or only natural persons should practice engineering. This is especially true in view of the fact that some states permit corporations to practice under their laws while others do not. No matter which position the Canons took, they would be illegal in some states. It would be rather self-defeating for the Canons of Ethics to encourage law breaking.

The Model Law can be changed either to permit or forbid the practice of engineering by corporations. Changing the Model Law, however, would accomplish little at this time. All of the states have already adopted some sort of registration law, and changes in actual laws rather than Model Laws are required to effect any legal change. Since these laws involved are State rather than Federal, it is a safe bet that they will never be uniform. Always, there will be some states permitting corporate practice and some forbidding it.

We do not think this question of corporate practice has anything to do with the Canons of Ethics. Corporations, as such, are not involved in ethics. The officers of the corporation are involved, and they, as individuals, are now guided by the Canons. Corporations are, on the other hand, subject to law. But it is too late for the Model Law to be changed to any practical purpose because there are already actual laws on the state statute books.

What is needed rather than a change in the Canons or the Model Law, is concerted opinion backed up by a firm stand on the part of the National Society of Professional Engineers and the Engineers Joint Council. How does the engineering fraternity feel about corporate practice? If NSPE and EJC knew the answer to this question and backed up their answer with strong lobbying efforts in the state capitals, we would need no changes in our Canons, and the most that would be needed so far as the Model Law is concerned would be an amendment adopted merely for an appearance of consistency. ▲

*For a copy of the Canons of Ethics For Engineers, suitable for framing, send 25¢ to CONSULTING ENGINEER, 420 Main Street, Saint Joseph, Michigan.

A Big Reason Why More Firms Are Switching to Copyflex . . .

PROBLEM-FREE INSTALLATION and OPERATION!

Model 93

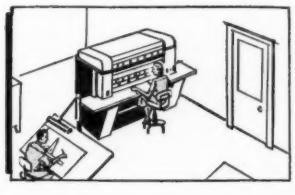
Because Copyflex reproduction machines are completely free from fumes and odors, they require no exhaust venting . . . they need no plumbing or auxiliary equipment, no installation other than an electrical connection.

Because they are absolutely clean, quiet, and odorless, they can be operated *anywhere* without annoyance to personnel in the vicinity.

That's why the people who handle reproduction, and know it best, prefer Copyflex. It's a big reason why more and more firms are switching to Copyflex!

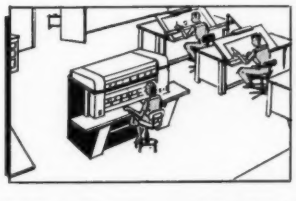
Why settle for less when it costs no more to own the one machine that offers you *all* the advantages of diazotype, positive black-on-white reproduction—speed . . . economy . . . quality—*plus* trouble-free installation and ideal operating conditions!

You'll find that Bruning also gives you the widest selection of reproduction materials available anywhere. Mail coupon for information on models and prices—today!



PUT IT HERE . . .
Near an inside wall—
no plumbing, no ducts!

PUT IT THERE . . .
Near an outside wall—
no vents in walls, windows!



PUT IT ANYWHERE!
Needs only an electrical connection for operation!

BRUNING *Copyflex*

Best Process! Best Machines!
Best Selection of Materials!

Specialists in Copying Since 1897

Charles Bruning Company, Inc., Dept. 1207.
4700 Montrose Ave., Chicago 41, Ill.
Please send me information on Copyflex Reproduction Machines.

Name_____ **Title**_____

Company_____

Address_____

City_____ **Zone**____ **State**_____

CHARLES BRUNING COMPANY, INCORPORATED • 4700 MONTROSE AVENUE • CHICAGO 41, ILLINOIS

the Legal Aspect

MELVIN NORD

Consultant in Legal and Technical Problems

Registered Professional Engineer

Patent Attorney

. . . liability of the master

IN A MASTER-SERVANT relationship such as exists between employer and employee, the master is liable for the damages incurred when the servant does a civil wrong (such as libel or negligence) upon a third person. This is the doctrine known as *respondeat superior* (let the master answer). It is as though the master himself had committed the wrong, his servant being the tool or instrumentality he used in so doing. This is an example of vicarious liability, i.e., of liability even though the master is personally without fault and offered no consent to be liable.

A similar situation exists in an agency relationship. The agent acts on behalf of the principal in business transactions. If the agent enters into a contract on behalf of the principal (within the scope of authority given the agent), the principal is bound by the contract whether he wishes to be or not. The act of the agent is regarded as the act of the principal. It is as though the principal himself had entered into the contract, his agent being the instrumentality that he used in so doing.

Danger Imposes Liability

Liability without fault may seem to be a pernicious doctrine, but it is by no means a novelty in the law. There are a number of other examples of such absolute or strict liability despite the absence of fault. For example, one who uses a "dangerous instrumentality" (such as dynamite) is responsible for the injuries that result from its use even though he is not at fault. In other words, the use of a dangerous instrumentality automatically imposes upon the user the liability of an insurer with regard to damages caused thereby.

The justification for strict liability is its social expediency. The burden is placed, for the benefit of those who are injured, on those whom society thinks can best bear it. The law does not generally place strict liability on a party unless he voluntarily engages in an activity that he regards as beneficial to himself, and under such circumstances that an innocent victim of these activities might otherwise have no relief. It is regarded as socially expedient to throw the risk of loss on the person who has the possibility of gain, rather than on the innocent bystander. This is the rationale behind the doctrine of *respondeat superior.*

The doctrine of *respondeat superior* does not really place an intolerable burden on the master or employer. He can and should carry liability insurance to cover this contingency. Thus, the risk of liability can be regarded as one of the costs of doing business. It is ultimately paid for by the consumers, i.e., by the public for whose ultimate benefit the doctrine exists.

Some Protection

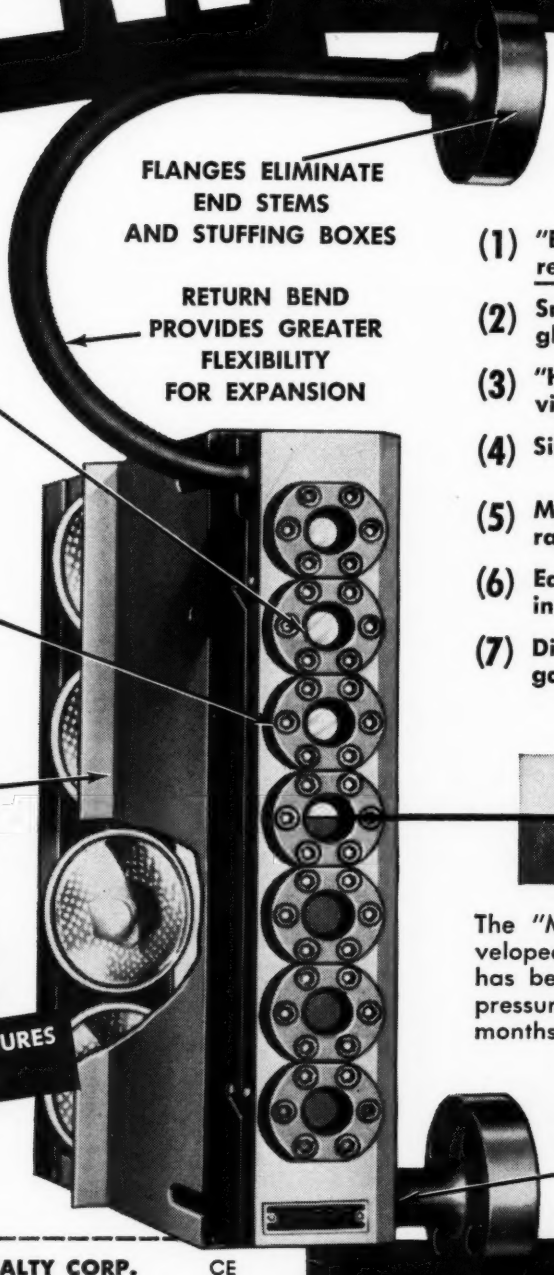
In theory, at least, the master also has some protection. First, the mere fact that the master is liable to the third person does not release the servant from liability as well. He is also liable to the third party. If the third party recovers damages from the servant, the master is released of liability. Second, if the master pays damages caused by the servant's negligence, the master has a right to recover those damages from the servant.

In other words, it is the servant who is ultimately liable, not the master. But the master acts as a sort of guarantor that the damages will be paid. In practice, this right of claim by the master against the servant is not worth much.

Keep in mind also that the "employer" is not subjected to the doctrine of *respondeat superior* if the person causing the damage is an independent contractor rather than a "servant." And the master is not responsible for every wrong his servant commits, but only those that arise out of, and in the course of, his employment. And if the third person releases the servant from liability, he automatically releases the master.

Look at some recent cases. In *Mid-Continent Pipeline Co. v. Crauthers,* 267 Pac. (2d) 563, an

NEW DIAMOND "MULTI-PORT"® Bi-Color Gauge



SMALL ROUND INDIVIDUAL PIECES OF MICA AND GLASS

PORT PARTS REPLACED WITHOUT REMOVING GAUGE FROM BOILER

"HI-LITE" ILLUMINATOR

FOR BOTH NEW AND OLD BOILERS

FOR BOILER PRESSURES TO 3000 PSI

FLANGES ELIMINATE END STEMS AND STUFFING BOXES

RETURN BEND PROVIDES GREATER FLEXIBILITY FOR EXPANSION

STEAM SHOWS RED

WATER SHOWS GREEN

WELDED CONSTRUCTION ASSURES PERMANENT TIGHTNESS

6962

"MULTI-PORT" Advantages:

(1) "Bi-Color" principle shows steam red and water green

(2) Small round ports instead of long glass strips

(3) "Hi-Lite" Illuminator for improved visibility

(4) Simplified high-pressure construction

(5) Maximum thermal stability for rapid starting

(6) Easy, inexpensive maintenance . . . in place

(7) Direct reading . . . basic reference gauge

The "Multi-Port" gauge has been developed over a four-year period and has been in continuous successful high pressure operation for more than 18 months in several leading central station plants. For additional information, write for new Bulletin 1174 . . . use the coupon below.

SEND TODAY

DIAMOND POWER SPECIALTY CORP. CE
LANCASTER, OHIO

Please send me without obligation a copy of new Bulletin No. 1174 explaining the advantages of the Diamond "MULTI-PORT" Bi-Color Gauge.

NAME_____

COMPANY_____

ADDRESS_____

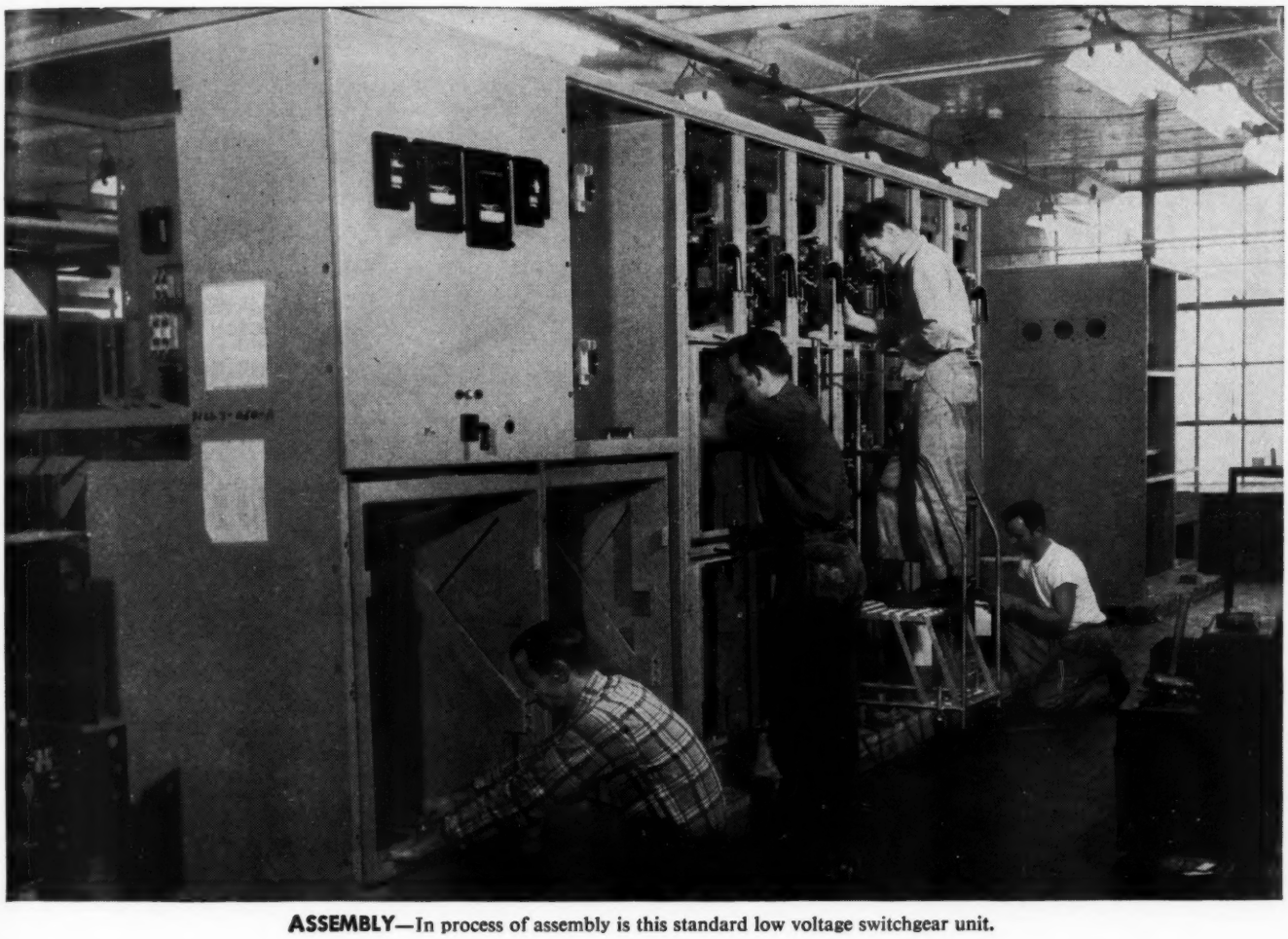
DIAMOND POWER SPECIALTY CORP.
LANCASTER, OHIO
Diamond Specialty Limited—Windsor, Ontario

Oklahoma case decided on Feb. 23, 1954, improper operation of the valves on a pipeline killed a pregnant cow. The owner put up quite a beef. It seems that Crauthers owned a certain piece of land, and Colpitt operated an oil lease on adjoining land. The Mid-Continent Pipeline Co. operated a pipeline to transport oil from Colpitt. Colpitt furnished power that operated the company's pump, the pump being located on the leased land. The pump was operated by an employee of Colpitt. The gauger of the company customarily gauged the tanks on the Colpitt lease. When one was ready for delivery, he notified Colpitt's pumper, who then connected the power to pump the oil into the pipeline.

Substitute Kills Cow

One day, the regular pumper was sick and a substitute was hired by Colpitt to take his place. Unfortunately, he failed to set the valves correctly. As a result, oil escaped onto Crauthers' land. A cow died within 13 days after drinking a quantity of the oil. The cow was due to drop a calf within 30 days of her death. Crauthers decided to sue for the cost of the cow, the calf, and other damages. Before suing, however, he executed a release of liability to Colpitt in return for payment of $300. He then sued the Mid-Continent Pipeline Co., as master, for the balance of his damages. "Too late," said the court. Once the servant is released of liability, there remains no further liability on the part of the master.

Roush v. Johnson, 80 S. E. (2d) 857, a West Virginia case decided on Jan. 20, 1954, involved death from electrocution caused by faulty electrical wiring. This case included a very interesting point of law. Bess Garton owned and operated a grocery store. The West Virginia Distributing Co. sold her an electrically operated refrigeration unit known as a compressor and beer cooler, and agreed to install it in a safe and proper manner. However, the company negligently installed the



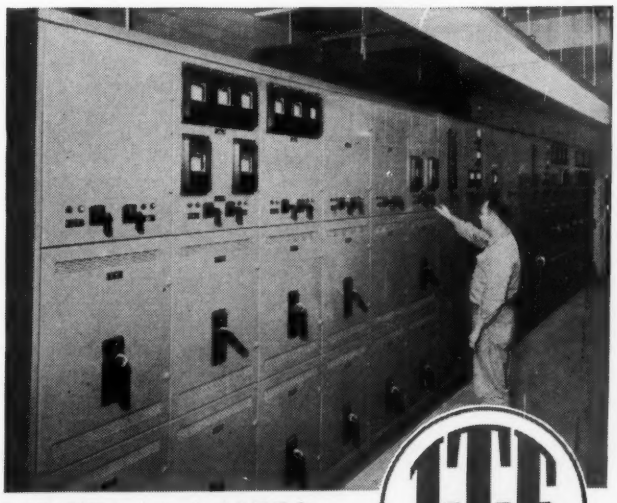
ASSEMBLY—In process of assembly is this standard low voltage switchgear unit.

A sound investment—standardize on I-T-E Low Voltage Switchgear

Before you specify low voltage switchgear, check the advantages offered by I-T-E. It is the finest of modern switchgear—factory assembled; shipped as a unit; ready to install; providing the maximum in dependability, safety, reduced maintenance costs, and attractive appearance.

I-T-E Circuit Breakers are the heart of the gear. Their performance in providing maximum protection has been proved conclusively in thousands of installations. I-T-E Structures are designed specifically to house and interconnect these time-tested protective devices and auxiliary equipment. When you combine the two, you get the finest of circuit breakers in the finest of structures—with much less special engineering, much faster delivery, and units tailor-made in standard frames to fit your requirements.

Standard I-T-E Low Voltage Switchgear Assemblies are available with ratings through 6000 amp continuous and 100,000 amp interrupting, 600 v a-c and 250 v d-c. For details, contact the I-T-E field office nearest you. Look in your classified directory under Electric Equipment, or write for Bulletin 8004A. I-T-E Circuit Breaker Company, Switchgear Division, 19th and Hamilton Sts., Philadelphia 30, Pa.



INSTALLED—A standard I-T-E low voltage switchgear unit in operation.

I-T-E CIRCUIT BREAKER COMPANY, Switchgear Division

unit in such a way that it was connected to the main switch and fuse box without the protection of the fuses or of the switch box.

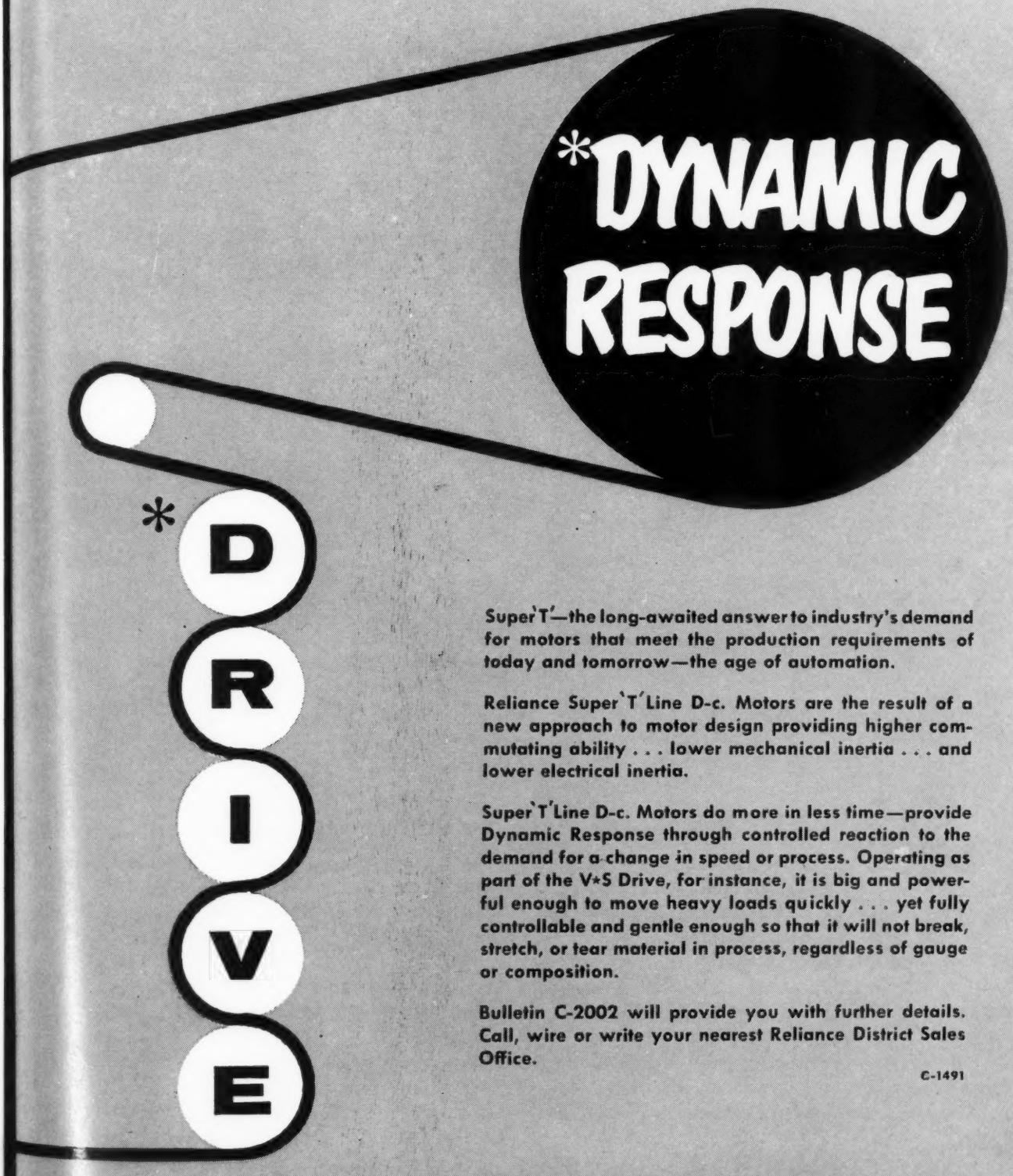
About six months later, Garton decided to move her store to another building and contracted with Fike to move the store. During the work, Fike's foreman, Jeffers, was electrocuted after he had opened the switch because of current running unknown to him to the equipment. Jeffers' administrator, Roush, brought suit against the owner of the company, Johnson, and also against Garton as the employer of Johnson. It was held that Johnson was not the servant of Garton, but an independent contractor, since Garton has no right to control Johnson's work.

Several Exceptions

One might have assumed that this would end the case insofar as Garton was concerned. But Roush argued that when the work is turned over to the owner and accepted by him, the owner becomes *substituted* as the responsible party for existing defects. As the court pointed out, this *is* the *general* rule, but it has a number of very important exceptions — namely when (a) the finished work is a nuisance, (b) there has been fraud or misrepresentation on the part of the independent contractor, (c) there is an express or implied warranty of fitness by the contractor, (d) the work is inherently dangerous or is so negligently defective as to be imminently dangerous to third persons and (e) the contractor knows of the defective condition of the work, even if it is not in itself inherently dangerous.

The court held that the liability remained on the independent contractor for the fourth and fifth reasons cited above. The work was imminently dangerous to third persons, and the contractor knew of the defect (or is chargeable with such knowledge). A verdict of $10,000 against the independent contractor was affirmed. The owner, Garton, was held to have no liability. ▲▲

The most revolutionary new motor development in 40 years!



Super'T'—the long-awaited answer to industry's demand for motors that meet the production requirements of today and tomorrow—the age of automation.

Reliance Super'T'Line D-c. Motors are the result of a new approach to motor design providing higher commutating ability . . . lower mechanical inertia . . . and lower electrical inertia.

Super'T'Line D-c. Motors do more in less time—provide Dynamic Response through controlled reaction to the demand for a change in speed or process. Operating as part of the V*S Drive, for instance, it is big and powerful enough to move heavy loads quickly . . . yet fully controllable and gentle enough so that it will not break, stretch, or tear material in process, regardless of gauge or composition.

Bulletin C-2002 will provide you with further details. Call, wire or write your nearest Reliance District Sales Office.

C-1491

Another of the Reliance Tools of Automation

REPORT FROM ZURICH

FRITZ D. HIRSCHFELD
European Editor

CE exclusive

ON MORE THAN one occasion, the opinion has been expressed by American consultants that there are practically no independent consulting engineers on the European Continent.

It may be time to dispel the rumor by introducing the International Federation of Consulting Engineers (of which the United States is not a member), founded in 1913, "to promote and develop the profession of Consulting Engineers and to establish and maintain an international body of competent, honorable, and independent experts."

The Federation is composed of Affiliated Associations of Consulting Engineers from ten European countries — Belgium, Denmark, Finland, France, Germany, Great Britain, The Netherlands, Norway, Sweden, and Switzerland. Each Association is represented by one delegate if there are 60 or less individual members in the Association or by two delegates if there are more than 60 individual members. The delegates from the Affiliated Associations act as a Committee. A chairman is elected and charged with the administration of the Federation. The present chairman is Robert A. Naef, consulting civil engineer, Zurich, Switzerland..

The express purposes of the Federation, according to the Statutes adopted by the Committee in Paris in 1937, are:

"To group existing Associations of Consulting Engineers or to further their creation, where such do not exist;

"To study in common, irrespective of all philosophical, political, or commercial considerations, all questions relating to the protection and development of the professional interests of the Members;

"To establish a bond of union and promote friendly and useful relations between the Consulting Engineers who combine the required qualities of competence, honorable character, and integrity;

"To promote the knowledge of what is done in the different countries in the way of Consulting Engineering, so as to facilitate the action and work of everybody;

"To generalize the application and observance of such rules of conduct as should guide the true Consulting Engineer in the execution of his profession or mission undertaken;

"To work for the development of his activity, and to watch over the maintenance of his reputation and dignity."

The Federation goes on to define the practices and principles of the affiliated membership:

"The Consulting Engineer practices an honorable profession free from commercial bias. He must be of strict integrity. He is not connected with trade or commercial business.

"He is remunerated solely by the fees paid to him by his client.

"His position in the industrial world is equivalent to that of the Barrister-at-Law and the Doctor of Medicine.

"He must retain absolute independence of action with regard to contractors, and he must never accept from them any kind of favor which might compromise the impartiality of his decisions or prejudice his duties to his clients."

As a rough indication of size of membership in the Affiliated Associations, Switzerland has approximately 60 consulting engineering firms for a total population of about 5 million. Western Germany, on the other hand has over 1000 consulting offices for a total population of about 50 million. There are, of course, differences in the functions, operations, and procedures of consultants from one country to the next throughout Europe.

Codes of Ethics

The Codes of Ethics adopted by the ten Associations of Consulting Engineers vary somewhat, but all are in fairly substantial agreement on these points:

¶ The consulting engineer must be a graduate (or equivalent) of a recognized technical school or university.

¶ Responsible professional experience (at least five years) is required before entering private consulting practice.

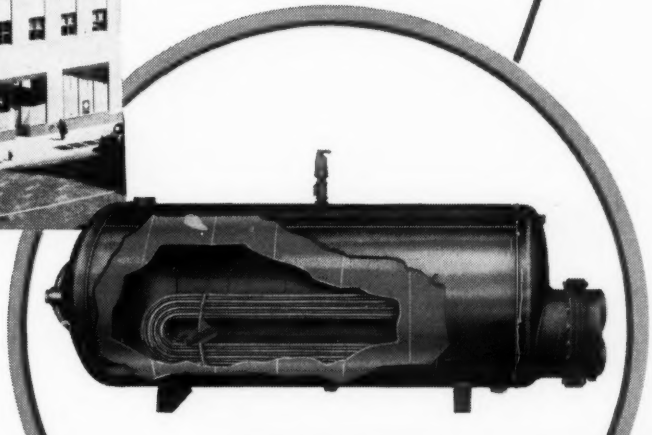
¶ The consulting engineer must be completely independent and impartial, and exercise his profession exclusively as a trustee of his client and not as a commercial agent.

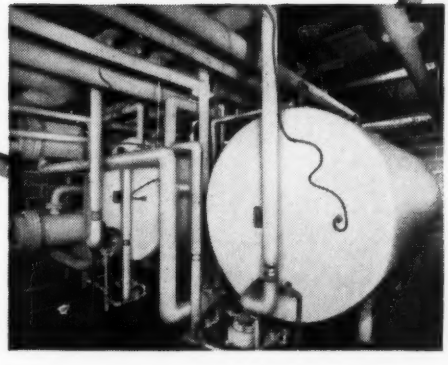
Some of the individual Associations are particularly sensitive on certain points. For example, the Code of Ethics in Great Britain states that; "No person shall be qualified for Membership of the Association if he shall advertise or canvass, or be connected with,

for Rust-Free Hot Water

look for the
Copper Lining

they did at
DUN and BRADSTREET





Copper-lined water heaters manufactured by **p-k** are a sound investment, especially for big, modern buildings such as the Dun and Bradstreet building. In their new office building at 99 Church Street in New York City, these copper-lined storage heaters supply 180 deg. F. water for the cafeteria and 130 deg. F. for general use. An abundant supply of rust-free hot water is constantly available at the turn of a spigot. The flawless operation of the heaters will save money—not only in heater upkeep but also in the proper maintenance of building services.

The **p-k** copper-lined heater is a complete copper heater built inside of a heavy steel shell. It combines non-corrosive properties of copper with the superior strength of steel.

For an unfailing source of pure, rust-free hot water—

Architects:
Reinhard, Hofmeister & Walquist
Consulting Engineers:
Syska & Hennessy, Inc.
Heating Contractor:
J. L. Murphy, Inc.

LOOK FOR THE **p-k** Copper Lining

Comprehensive catalog gives you all the facts. It's yours for the asking.

the ***Patterson-Kelley Co.,*** inc.

1730 Burson Street, East Stroudsburg, Penn.

2503

101 Park Avenue, New York 17 • Railway Exchange Building, Chicago 4 • 1700 Walnut Street, Philadelphia 3 • 96-A Huntington Avenue, Boston 16 • and other principal cities.

or interested in any company, firm or person who advertises or canvasses for Consulting Engineers' work."

The British code under "Duties of Members" also forbids its members to:

"... solicit professional work either directly or indirectly or by an agent, nor shall he pay, by commission or otherwise, any person who may introduce clients to him.

"... advertise directly or indirectly for professional employment, nor shall he answer any advertisement for a Consulting Engineer.

"... knowingly compete on the basis of professional charges with another Member for employment.

"... attempt, directly or indirectly to supplant another Member, nor shall he review or take over work of another Member acting as a Consulting Engineer for the same client, until he has either obtained the consent of such Member or has been formally notified by the client that the connection of such Member with the work has been terminated.

"... take part in a competition involving the submission of proposals and designs of engineering work unless an assessor who shall be an engineer of acknowledged standing has been appointed, to whom all such proposals and designs are to be submitted for adjudication."

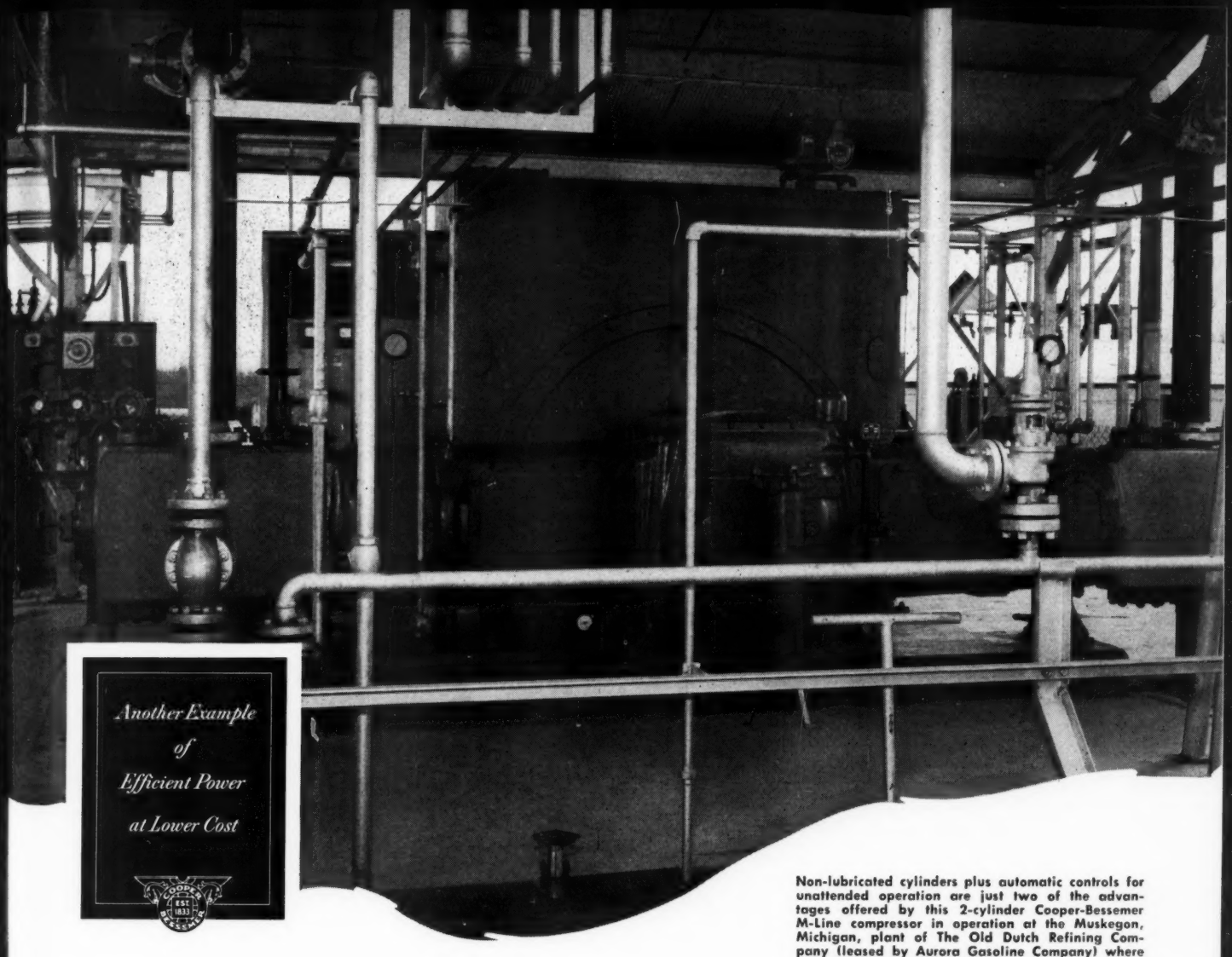
On the Continent

In The Netherlands, the Code includes this warranty: "... the Membership of the Association offers a guarantee (to the client) in regard to the competence and the impartiality of its Members ...."

And Sweden puts some "teeth" into its Code with this statement: "When joining the Association, each Member shall hand over to the Council a promissory note for 10,000 Swedish Kronor ($2,600), payment to be made on demand. Should a Member not observe the above-mentioned rules and should he not submit to correction within the six weeks' notice given by the Council to that effect, the Council is entitled to exact the above amount from him.

"Each Member is bound to accept the decision of the Council without any right to protest if any client for whom he has carried out some work as Consulting Engineer should appeal to the Council regarding the fee charged, unless this fee has been fixed by agreement in writing, or regarding the interpretation of such an agreement, provided that the lodger of the complaint should at the same time declare that he, for his part, will be content with the decision of the Council. Upon receipt of such a complaint the Council shall, after having given both parties an opportunity for expressing their opinion, decide the case and deliver judgment to both parties, free of charge."

The German Association has this to say about fees: "The Members have to maintain the rules and regulations of the national Association, as well as the



Non-lubricated cylinders plus automatic controls for unattended operation are just two of the advantages offered by this 2-cylinder Cooper-Bessemer M-Line compressor in operation at the Muskegon, Michigan, plant of The Old Dutch Refining Company (leased by Aurora Gasoline Company) where the UOP Platforming process is in use.

"HYDROGEN COMPRESSES CLEAN"

... with Cooper-Bessemer's non-lubricated cylinders

RECYCLING millions of cubic feet of hydrogen a day for the UOP Platforming of low-octane gasoline, demands continuing efficiency from a smooth working compressor that will not contaminate the recycle hydrogen. That is one of the reasons why The Old Dutch Refining Company, leased by Aurora Gasoline Company, recently installed a 2-cyclinder Cooper-Bessemer FM compressor in their modern plant in Muskegon, Michigan.

To avoid contaminating hydrogen with oil in the recycle gas, Cooper-Bessemer successfully developed a non-lubricated compressor cylinder.

Operating against micro-smooth hardened cylinder liners, these 8" diameter carbon pistons require no lubrication whatever. With a mirror finish, the cylinder bores reveal no excessive wear.

No matter how exacting or complex your compressor problems, check the advantages offered by Cooper-Bessemer M-Line compressors. For dependability and money-saving operation, you can rely on Cooper-Bessemer — one of America's oldest engine builders offering the latest in engineering advancements.

MOUNT VERNON, OHIO

COOPER-BESSEMER

GROVE CITY, PENNA.

New York City • Seattle, Wash. • Bradford, Pa. • Chicago, Ill. Houston, Dallas, Greggton, Pampa and Odessa, Texas Washington, D. C. • Shreveport, La. • San Francisco, Los Angeles, Calif. • St. Louis, Mo. • Gloucester, Mass. • New Orleans, La. • Tulsa, Okla. • Cooper-Bessemer of Canada Ltd., Edmonton, Alberta—Halifax, Nova Scotia.

DIESELS • GAS ENGINES • GAS-DIESELS • ENGINE-DRIVEN AND MOTOR-DRIVEN COMPRESSORS

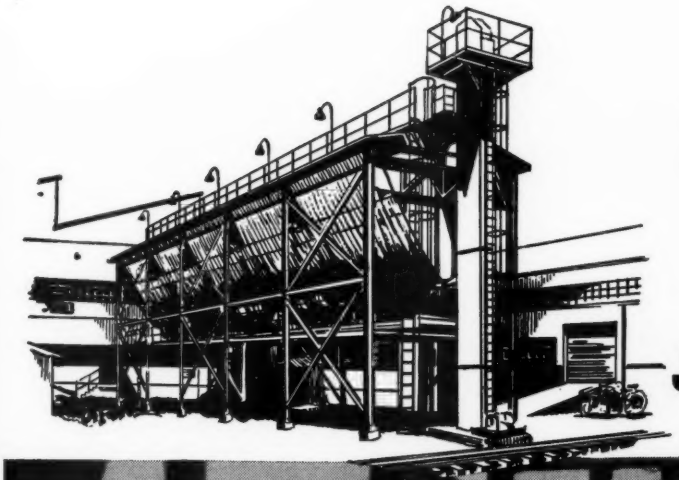
scale of fees, recognized by the Association, in particular the special tariff schedule for engineers."

While a Code of Ethics is one thing, actual practice may be quite another matter. It will be interesting to visit with the various National Associations as well as with the individual member consulting engineers, and to learn how much of this is enforced. Are these mere words or is there real action involved?

Before the War, European consultants tended to be older men, perhaps retired from industry, who had won broad recognition for their ideas and accomplishments. The term "consultant" may have even carried an honorary significance in those days.

However, following World War II, the pattern has changed. Younger men have entered the consulting profession. Through their National Associations and the International Federation, these younger consulting engineers are fighting hard to win recognition for their profession, to do away with discriminatory laws or legislation, and to change antiquated concepts of how and by whom engineering work should be performed. The European consultant is now firmly established.

Little has been done by the American consultants or the representative engineering societies to cooperate with the European Associations and their Federation. The European consultants have an excuse for not making the initial overtures. After all, they have the Federation. ▲▲



VERSATILE...

is the word for JEFFREY standard units

Line drawing: Jeffrey Standard Bucket Elevator feeding storage bin.

Photo: Jeffrey Twin-Spiral Conveyor System handling finished cement from mill to railroad cars for bulk shipment.

OTHER JEFFREY STANDARD UNITS
BELT CONVEYORS
APRON CONVEYORS
SCRAPER CONVEYORS
POWER SCOOPS

Jeffrey Standard Spiral Conveyors and Bucket Elevators are available in a range of types and sizes that meet practically every industrial requirement and operating condition.

Each Spiral Conveyor is completely assembled in our plant to assure perfect fit and alignment. Before dismantling for shipment, parts are match-marked to facilitate field erection.

Split-head Sections are available on Jeffrey Standard Bucket Elevators. New High-Front Buckets on continuous types increase the versatility of the line.

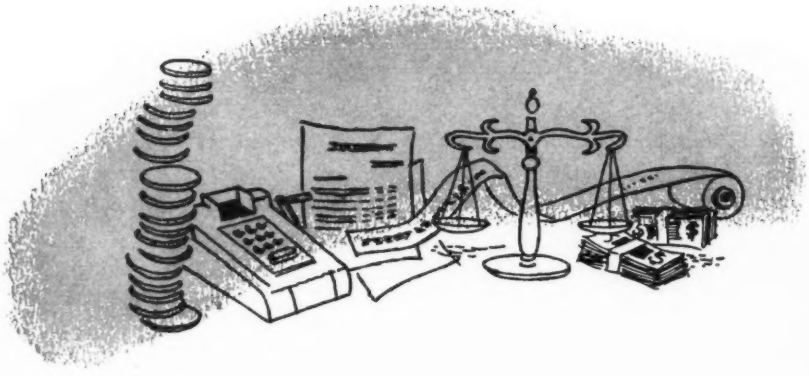
WRITE FOR CATALOGS CONTAINING COMPLETE INFORMATION.

THE JEFFREY MANUFACTURING CO.

ESTABLISHED 1877
Columbus 16, Ohio
sales offices and distributors in principal cities
PLANTS IN CANADA, ENGLAND, SOUTH AFRICA

IF IT'S MINED, PROCESSED OR MOVED
. . . IT'S A JOB FOR JEFFREY!

ECONOMIC NEWS NOTES



E. F. Mac Donald
INDUSTRIAL ECONOMIST

"AMERICA'S RUHR" — Holding that "Low cost transportation, coupled with abundant fuel, electric power and water, is the keystone of industrial growth," Mr. P. M. Zeis, vice president of Riverlake Belt Conveyor Lines, holds that the upper Ohio River Valley is moving into a new phase of accelerated industrial expansion. He maintains that this expansion cycle will result in outlays for new plant construction of over $2 billion in as short a period as three years. This growth is taking shape with chemical industries first, now atomic, and in the future, aluminum to be added to the basic steel and metal fabricating plants. This will be accentuated by the St. Lawrence Seaway.

DOUBLE TIME — New York State will have to spend almost twice as much on construction in the next decade as in the past 10 years if it wants to do nothing more than just maintain present services. This is one of the findings reported by the Temporary State Commission on Fiscal Affairs to Gov. Harriman. The Commission forecasts a 10% population increase in the next decade that would require a minimum of $2.7 billion of construction outlays simply to continue current services for such a population. It recommended annual expenditure of $150 million on capital construction.

NEW CONSULTANTS — Carrying the idea of "sidewalk superintendents" quite a step forward, New Jersey commuters were recently asked to select the colors for repainting the walls of stations and for redoing the interiors of Hudson & Manhattan tube trains.

SUCCESS STORY — It's construction time on the New Jersey Turnpike again. They're beginning a $26-million project of widening part of the 4-lane pike to 6 lanes. This is partly in anticipation of the heavier volume of traffic expected to result from future extensions and connections with other primary highways. Traffic on the N.J. Turnpike is well ahead of earlier estimates—the actual load last year was not looked for until 1981.

PROPER PERSPECTIVE — Expressing alarm at propaganda designed to discourage technological progress, Mr. B. F. Fairless stated recently, "This thing called automation is simply evolution—not revolution. It is only another little step in the slow and plodding progress of man towards a richer, fuller life, and a better, freer world." He cited the late labor leader Philip Murray as saying, "I do not know of a single, solitary instance where a great technological gain has taken place in the United States of America that has actually thrown people out of work."

FOR SALE — The largest surplus disposal project ever undertaken by a private concern is the $24 million sale of construction and mining equipment and living facilities from the Alcan project in Kitmat, B. C. The S. & S. Machinery Co., Brooklyn, is handling the job which, it is estimated, will run to 1957. This company is preparing a catalog of the wide variety of equipment available.

PERENNIAL PLAINT — Stating that "Many companies are still paying 1945-sized salaries," Mr. H. DeWitt Smith, president of the American Institute of Mining and Metallurgical Engineers, warned the mining industry that it must pay higher salaries if it is to avoid a serious shortage of engineers. He said that the scarcity was pointed up by the fact that only 300 mining engineers were graduated last year and only half that number would get degrees in 1956.

GOING DOWN — Average occupancy of 400 large hotels fell to 72% last year, marking the 8th successive year of decline from an occupancy rate of 93% in 1946. Horwath & Horwath, accountants, add that a 3% increase in room rates offset the rental drop to produce a volume of dollar receipts just under the record figure for 1953.

THROUGH THE TRANSIT — If approved, the Administration's National Highway Program would mean that an average of about 130,000 more full-time site workers would be needed on roadbuilding in 1957 than at present . . . The Associated General Contractors of America estimates that direct construction employment in 1954 was 4.6 million, and that total employment in all fields connected with construction was 9.4 million, over 17% of all full-time workers. It also figures that for every five workers at the site of new construction, six are employed in activities servicing it . . . Toll revenue on the Pennsylvania Turnpike for 1954 fell about 1% below 1953; December receipts, however, were 15% above a year earlier . . . General Sturgis, chief of Army Engineers warns that we face a water shortage that "could stagger the nation" unless something is done about it soon . . . In urging reduced Federal spending next fiscal year, NAM has recommended a cut of over $1 billion in eliminating new programs, particularly for public works and public welfare . . . The 1.3 million housing starts looked for this year by Housing and Home Finance Administrator Cole will be about double the number of new families formed during the year . . . State and municipal financing in January was the second highest January on record—here are funds for future construction activity.

ATOMS IN ACTION

CONSULTING ENGINEERS are being given consideration by the AEC as a group particularly important in developing civilian uses of nuclear reactors. Revision of the Industrial Participation Program following the enactment of the Atomic Energy Act of 1954 will make it possible for increasing numbers of organizations to make evaluations of the commercial prospects for atomic energy. To this end, the AEC is setting up three types of agreements for industrial participation. The first — access agreements — will make available information on reactor technology that is classified "Confidential -- Restricted." These agreements will permit limited evaluations, at least. The second category of participation — study agreements — is essentially the same as that in force since 1950. It will permit access to "Secret — Restricted" data. However, the new study agreements will require more specific reporting to, and supervision by, the AEC. The third type — commercial agreements — will make available data to those actually engaged in commercial reactor technology activities as opposed to those merely studying the prospects of such activity.

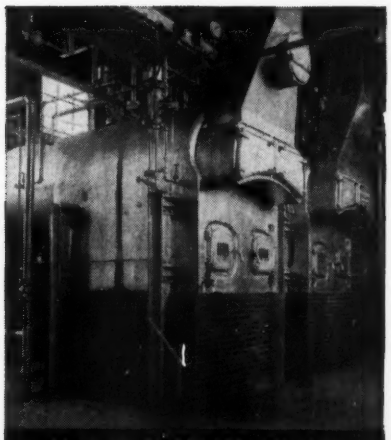
AN APPRAISAL of the Industrial Participation Program to date shows that 22 study group agreements have been executed since the AEC approved the Program in December of 1950. The total cost of the Program to the AEC, as of the end of the fiscal year 1954, was $344,000. On the other hand, the estimated expenditures by the study groups themselves total $4,900,000.

THE ATOMIC POWER Development Associates (led by Walker Cisler, president, Detroit Edison) are now planning to build a 100-mw (electrical) experimental breeder reactor as a step toward economically competitive power — the entire cost of $50 million coming from private funds.

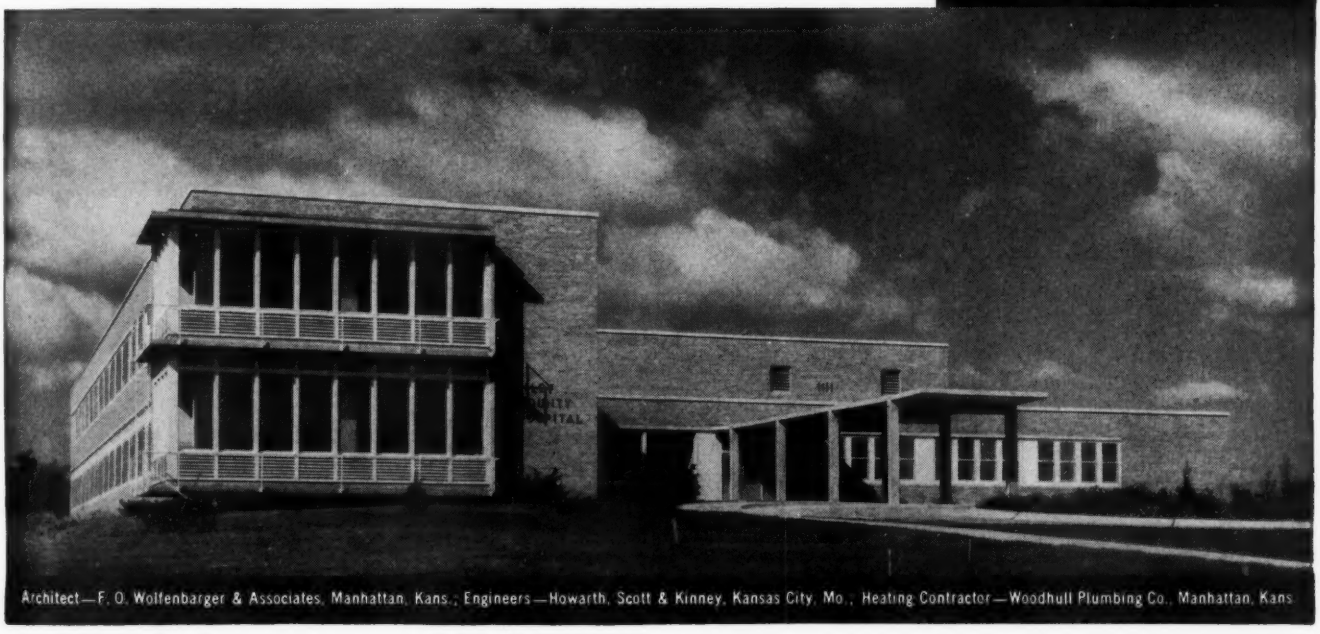
BURNS AND ROE, New York City, have been awarded the work as general contractor for the conventional portion of the nation's first full-scale central station atomic power plant being built by Duquesne Light at Shippingport, Penn. Burns and Roe will be associated with J. Rich Steers and with Hatzel and Buehler for this project.

THE ASME will contribute $10,000 to a $25,000 joint project with the AEC to develop information in the field of high-temperature piping. The ASME will also make available at no cost to the government the services of a group of technical experts for programming and evaluating the work. . . . George L. Weil has been named Technical Director for United States Participation in the International Conference on the Peaceful Uses of Atomic Energy. This is the meeting scheduled for next August in Geneva, Switzerland, as a result of President Eisenhower's atoms-for-peace proposals. . . . India will be allowed to purchase 10 tons of heavy water from the AEC for a research reactor near Bombay. . . . Traveling under sponsorship of the Fund for Peaceful Atomic Development, Dr. Lawrence Hafstad will tour halfway around the world as our unofficial "atomic ambassador". . . . The AEC has released a fact sheet on the portable thulium X-ray unit it developed at its Argonne National Laboratories. Technical information and limited consultation will be provided to firms interested in commercially developing the X-ray device. ▲▲

PROTECTION OF LIFE BEGINS IN THE BOILER ROOM OF A HOSPITAL . . .



Here are 2 #584 125# Firebox Steam Boilers for gas or oil



Architect—F. O. Wolfenbarger & Associates, Manhattan, Kans.; Engineers—Howarth, Scott & Kinney, Kansas City, Mo.; Heating Contractor—Woodhull Plumbing Co., Manhattan, Kans.

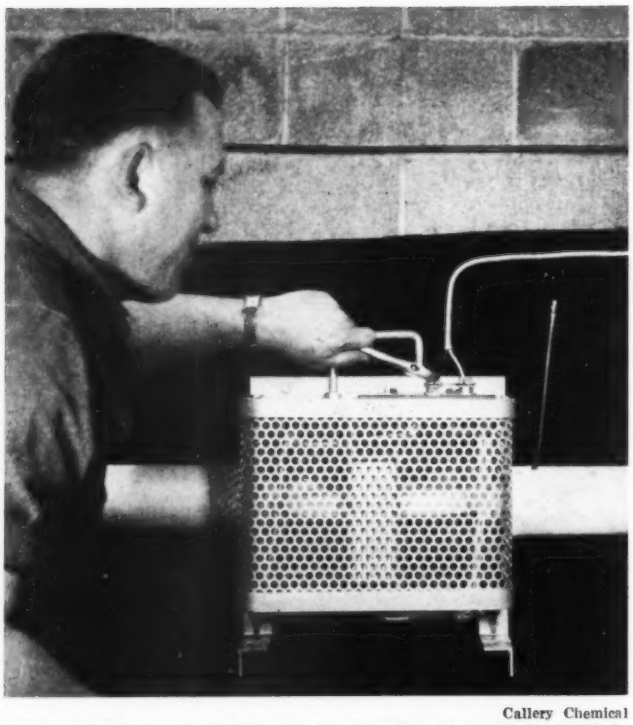
KEWANEE

reserve plus rated boilers . . .

GUARANTEE EXTRA POWER TO MEET EMERGENCIES

When you think of protecting life in hospitals, you probably first think of spotless operating areas, sanitary rooms, fresh clean linen on gleaming white beds. And they're all important, too. But such safeguards would be for naught if power failed in the boiler room when emergency called. So, Architect F. O. Wolfenbarger and Engineers Howarth, Scott & Kinney made sure in planning for the Riley County Hospital, Manhattan, Kansas. Kewanee Reserve Plus Boilers were selected because they are certified to deliver 50% extra power, that measure of protection always "on call" no matter what the need. So, don't be misled by promises that a boiler delivers enough steam to meet average daily requirements. Be sure there is extra reserve to take care of unusual conditions. For that is when performance beyond the call of usual duty is a necessity. Kewanee Reserve Plus Rated Boilers guarantee that protection.

YOU can depend on KEWANEE engineering



Callery Chemical

AN ALTERNATING CURRENT, CONDUCTION TYPE ELECTRO-MAGNETIC PUMP INSTALLED IN A LIQUID METAL LINE.

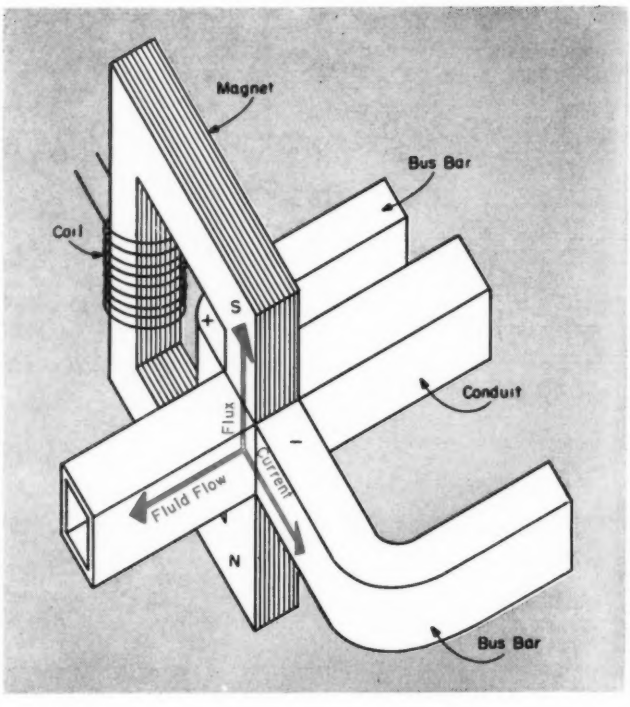


FIG. 1. IN D-C CONDUCTION PUMP, FLUID FLOW IS AT RIGHT ANGLE TO CURRENT FLOW AND MAGNETIC FIELD.

Pumps—With No Moving Parts

Ce exclusive

GLENN MURPHY
Iowa State College

Dr. Glenn Murphy was graduated from the University of Colorado with special honors in 1929, taught part-time there the following year, and received the M.S. degree in 1930. From 1930 to 1932, he was Research Graduate Assistant at the University of Illinois in the Civil Engineering Department, and received an M.S. degree in 1932. In 1932, he went to Iowa State College as Instructor in Theoretical and Applied Mechanics, and has been associated wtih Iowa State College since. In 1935, he received the Ph.D degree from Iowa State College, and in 1937, was awarded the degree of Civil Engineer by the University of Colorado. Dr. Murphy became Professor of Theoretical and Applied Mechanics at Iowa State in 1941, and in 1949, was appointed Senior Engineer in charge of Engineering Development with the Institute for Atomic Research. In 1952 he was appointed Professor and Head of Aeronautical Engineering at Iowa State.

Dr. Murphy is the author of five college textbooks, co-author of a sixth, and has written numerous papers. In 1951, he was named recipient of the George Westinghouse Award of the American Society for Engineering Education "in recognition of distinguished contributions to the teaching of students of engineering."

ELECTROMAGNETIC PUMPS differ from other types of pumps in that they have no moving parts and require no seals. These characteristics are obviously advantageous in a number of practical situations, as in the pumping of those liquid metals that burn or explode on contact with the atmosphere. The problem of providing adequate seals around shafts or connecting rods, which is critical with other types of pumps, is entirely eliminated by use of an electromagnetic unit. A pump with no internal parts is particularly attractive for moving radioactive materials, since servicing can be accomplished without opening the system and running the risk of excessive exposure of employees.

A pump with no moving parts may appear to be an impossibility, but the basic principle involved in the construction and operation of such units has been known for many years. Recent urgent needs for

devices to move liquid metals at high temperatures and materials that are radioactive have stimulated their development.

The fundamental principle involved in an electromagnetic pump is the same as that on which the operation of an electric motor depends: a mechanical force is developed whenever an electric current is passed through a magnetic field in such a way that the current crosses the lines of magnetic flux. The application of this principle has led to the development of two general types of electromagnetic pumps. These are known as the conduction (Faraday) type and the induction type.

The Conduction-Type Pump

In the diagrammatic representation of a d-c Faraday pump (Fig. 1), the section of the conduit constituting the active portion of the pump is constructed so as to pass through a magnetic field. The poles of the magnet are represented by N-S. The current is supplied through bus bars welded or otherwise attached to the walls of the conduit on opposite sides so that this current flows directly through the fluid being pumped. This current flowing in a magnetic field develops a force at right angles to the direction of the current flow and the direction of the magnetic field. As a result of this force, the fluid flows through the conduit. The direction of the current, the magnetic field, and the direction of fluid flow are shown by the colored arrows on the illustration of a d-c conduction type electromagnetic pump.

The theoretical increase in pressure developed by the pump is

$$\Delta p = \frac{KBI}{d} \qquad (1)$$

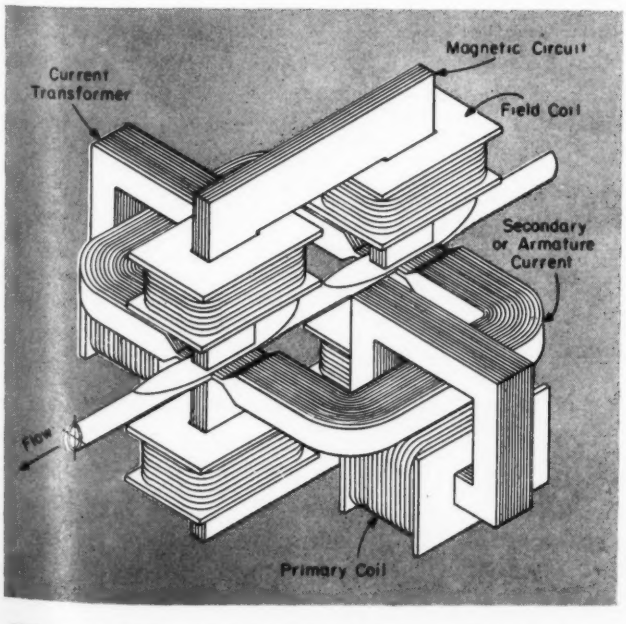


FIG. 2. TRANSFORMER PROVIDES HIGH CURRENT AT LOW VOLTAGE FOR ALTERNATING CURRENT CONDUCTION PUMP.

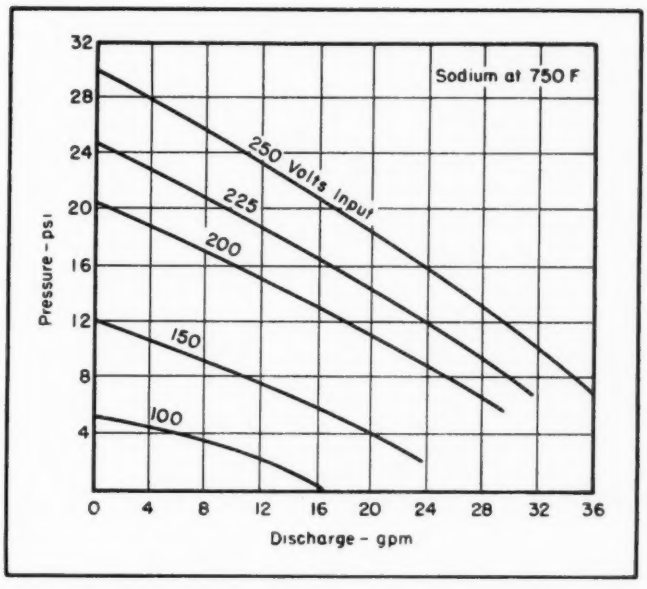


FIG. 3. PERFORMANCE CURVES FOR AN A-C CONDUCTION TYPE PUMP AT VARIOUS VOLTAGE INPUTS (100 TO 250 V).

in which Δp = pressure in psi
$K = 8.85 \times 10^{-8}$
B = field strength in lines per sq in.
I = effective current in amperes
d = height of duct in in.

The effective current may be approximated taking into account factors such as eddy current loss, fringing effect (unless the magnetic field extends well beyond the electrodes), back voltage or voltage induced in the field by the moving fluid, electrical resistance of the fluid, and electrical resistance of the conduit walls. Then, the expression for the effective current takes the form

$$I = \alpha I_L - CV \qquad (2)$$

in which alpha and C are constants dependent upon materials and dimensions.

I = effective current
I_L = line current
V = voltage across the electrodes

From Eq. (1) and (2) it is seen that a high line current and a low voltage are favorable to the development of a high pressure increase in the pump. In practice, it has been found that pumps of several designs have peak efficiencies at approximately one volt. The corresponding currents range from a few amperes to several thousand amperes depending on the capacity of the pump.

Even though the efficiency of a d-c conduction-type pump may be as high as 60 percent, the large current requirement for high-capacity pumps presents practical difficulties. One solution to the problem is the use of an a-c system (Fig. 2) so that a transformer can be incorporated into the design. With this design, conventional line voltages and currents can be utilized to supply the low-voltage and high-current requirements of the pump. When both the flux and the current are reversed, the direction

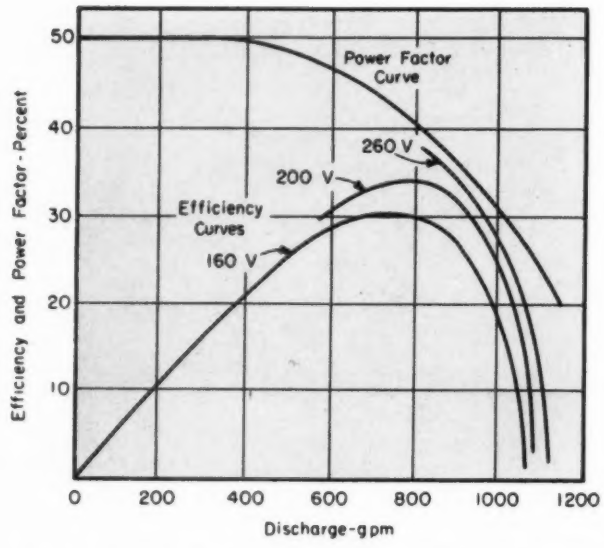


FIG. 4. EFFICIENCY AND POWER FACTOR CURVES FOR A LINEAR INDUCTION PUMP AT 160 V, 200 V, AND 250.

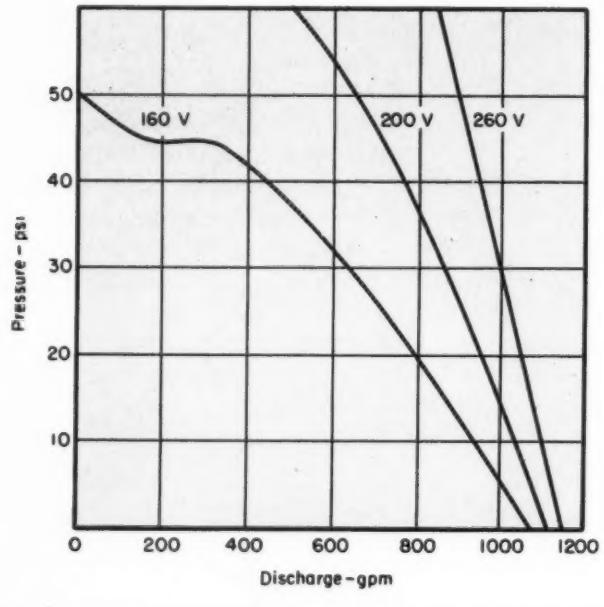


FIG. 5. PRESSURE VS DISCHARGE FOR LINEAR INDUCTION PUMP AT THE SAME VOLTAGES AS IN CHART ABOVE.

of flow is unchanged. Hence, by using a common a-c source for the flux and the current requirements or by using separate sources with no phase change between them, a constant direction of pressure increase can be maintained.

From the standpoint of power supply, the a-c conduction-type pump has some advantages over the d-c type. However, the analysis of the a-c conduction-type pump presents several difficulties. Efficiencies are lower than can be obtained with the d-c conduction-type pump, being in the order of 15 to 20 percent under favorable conditions. One of the factors contributing to the lower efficiency of the a-c type in comparison to the d-c type is the increased flux leakage induced by the alternating field. The efficiency is also a function of the phase difference between the magnetic field and the current.

Despite their low efficiencies, pumps of the a-c type have found favor in laboratories because they can be designed to operate readily on the conventional 110-v system. The pumps may be designed as shunt-field or series-field systems. Auxiliary cooling may be required for the shunt-field windings if the pump is used with liquid metals at elevated temperatures. Performance curves for one pump (Fig. 3) indicate a general similarity to the curves for a small centrifugal pump.

Induction-Type Pumps

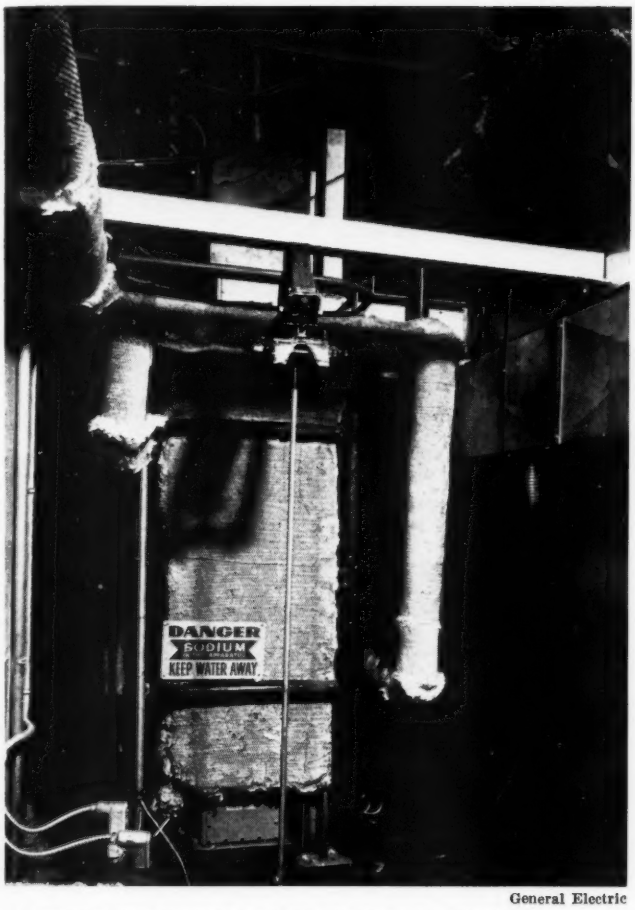
The induction-type electromagnetic pump, which is analogous to the induction-type motor, differs from the conduction-type pump in having a moving magnetic field. The moving field induces currents in the liquid metal, and a force results from the interaction of the current and the magnetic field.

The two classes of induction-type pumps that have been developed are the linear-flow induction-type pump and the helical-flow induction-type pump. In principle, the linear-flow induction-type pump consists of a straight section of conduit along which is arranged a series of magnetic poles, with adjacent poles having opposite polarity. The magnetic field, actuated by polyphase a-c current applied to the magnet windings, travels along the effective section at the rate of one pole pitch distance for each half cycle of current. The moving field induces currents in the fluid, and the accompanying forces tend to make the fluid follow the moving field.

From the information available it appears that this type of pump is suited for moderate-head, high-discharge applications. Peak efficiencies between 30 and 40 percent have been developed in the 1000-gpm range. The performance curves for one linear induction pump operated at three different voltages are illustrated (Fig. 4).

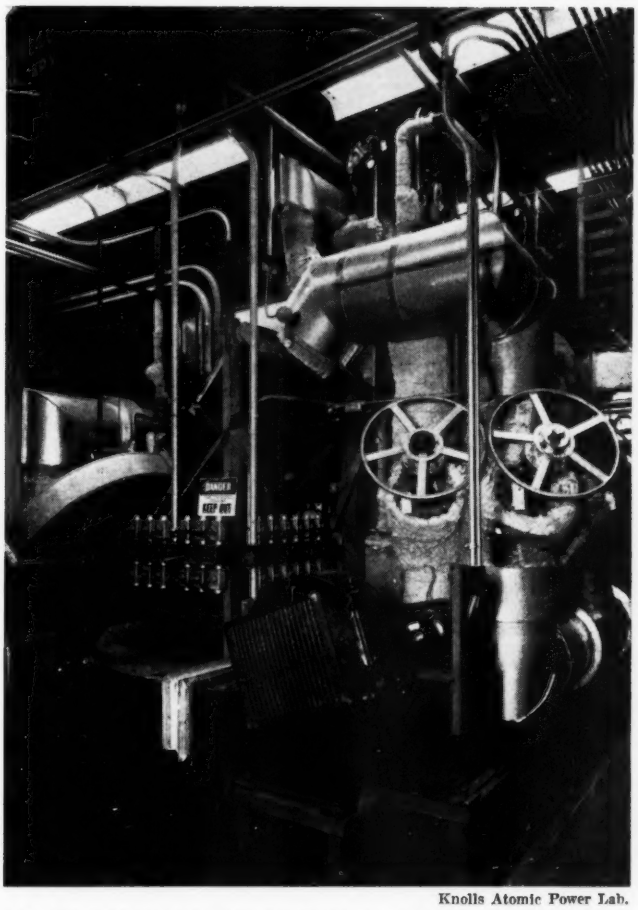
Higher pressures at lower discharges are obtained with helical-flow induction-type pumps. In this type, the effective length of the pump consists of a helical passage around which is arranged a three-phase multi-pole winding to provide a moving magnetic field. The helical passage may be formed by two concentric tubes with annular space between them containing a series of separator strips wound spirally along the annulus. A given drop of the fluid, entering at one end of the section, flows along some one of the helical passages to the other end of the effective section. Stacked iron laminations are placed within the inner tube.

In operation, the rotating multiple-pole magnetic field set up when alternating current is applied to the stator windings induces voltages in the fluid and causes current to flow in the fluid in much the same manner as current is induced in the rotor of an induction motor. As a result, the fluid tends to follow the



General Electric

A LINEAR INDUCTION PUMP USED FOR PUMPING OF LIQUID SODIUM AT 580 TO 1000 F AND 0 TO 75 PSI PRESSURE.



Knolls Atomic Power Lab.

TILTED BOX IN FOREGROUND IS A 3-PHASE, 440 VOLT LINEAR FLOW INDUCTION PUMP IN AN AEC INSTALLATION.

rotating field, but it is given a longitudinal component of motion by the separator vanes in the annular passages between the tubes.

The angular velocity of the fluid is less than the velocity of the field, the difference being the slip, which is analogous to the slip of an induction motor. For a given impressed voltage, the pressure rises as the slip increases. The pressure rise developed is also dependent upon the helix angle of the passages, with a flat helix resulting in a relatively high pressure.

In general, the efficiencies of helical-flow pumps are lower than those of linear-flow induction-type pumps, being in the 10 to 20 percent range, but the helical-flow pumps develop higher pressure. Heads up to 260 ft of sodium have been reported.

Applications

One of the great advantages of electromagnetic pumps over the conventional centrifugal, rotary, and reciprocating pumps is the complete elimination of moving mechanical parts within the pump. With moving parts eliminated, shafts and piston rods are not required, so there are no seals around which troublesome or disastrous leakage can occur.

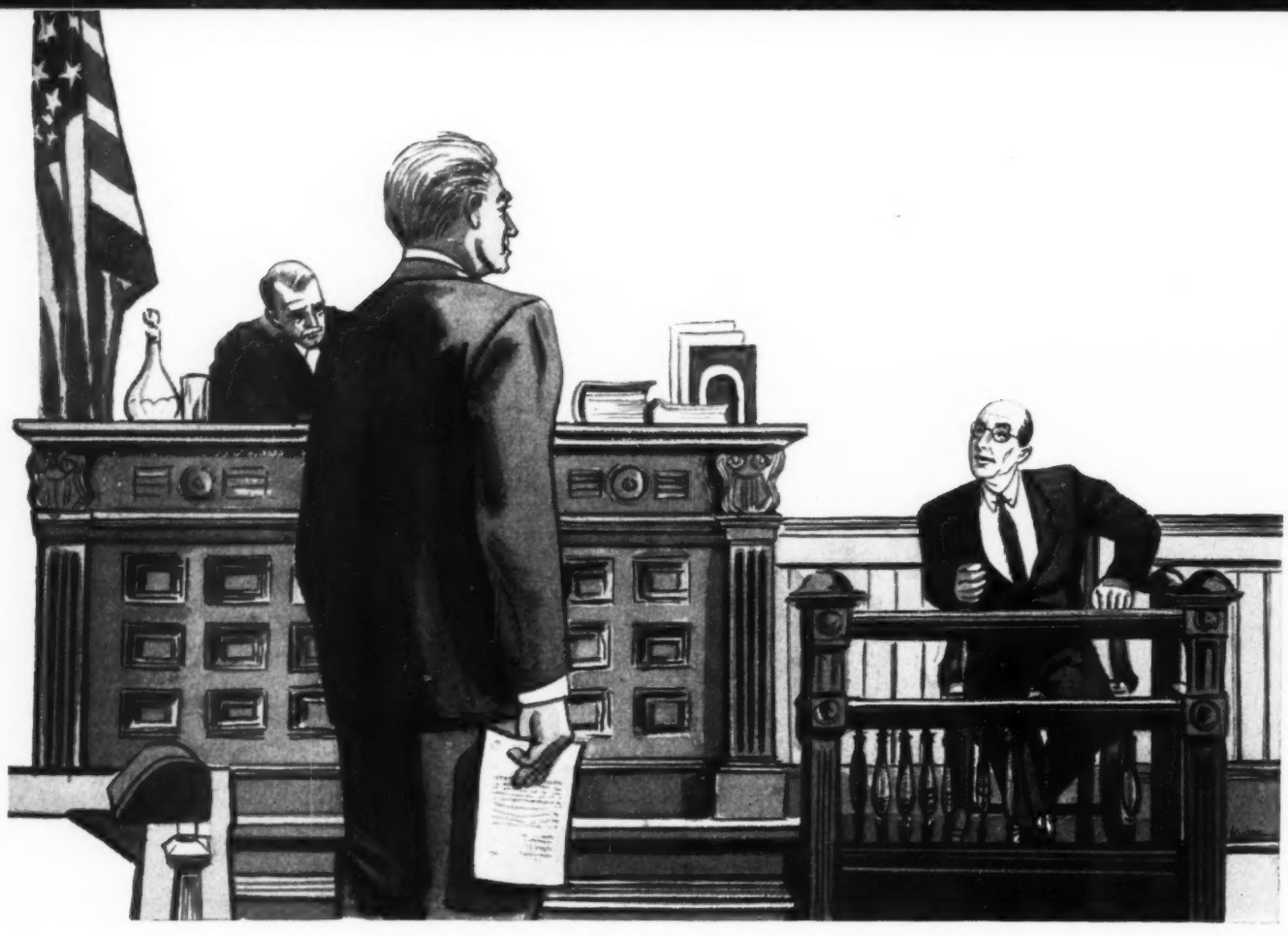
Electromagnetic pumps are therefore well suited for use with liquid metals such as hot aluminum, magnesium, sodium, potassium, and their alloys, which may ignite or explode on exposure to the atmosphere. These metals have a sufficiently high electrical conductivity to be pumped effectively. Use of electromagnetic pumps in aluminum and magnesium foundries provides a practical means of transferring the molten metal from the furnace to the mold.

With the increasing interest in power development from nuclear reactors, there has arisen the need for fluids more effective than water or steam for removing heat from the reactor. The high rates of heat transfer involved in several designs plus some other problems have made the use of liquid metal coolants imperative. Sodium, potassium, lithium, and their alloys are among the heat-transfer media that have received consideration. For handling these metals, an electromagnetic pump has obvious advantages.

The pumping of fluids that have become radioactive is another situation in which it is imperative to eliminate all possibility of leakage around seals. If the electrical conductivity of the fluid is adequate, an electromagnetic pump can be used effectively. The elimination of leakage also is advantageous in other situations where radioactivity is not involved.

The ease of maintenance of an electromagnetic pump is another point in its favor. With no moving parts within it, there is nothing to wear out and no

—Continued on page 78



The Engineer - Expert Under Cross Examination

CE exclusive

ROBIN BEACH
Consulting Engineer

If you ever find yourself testifying in court as an expert witness, be prepared to face cross examination. Here an expert at being an expert witness gives the benefit of his experiences.

CROSS EXAMINATION is a right granted by courts for developing information that was not sufficiently covered on direct examination or to reveal additional evidence beyond the scope of direct examination. It also may be used to show the credibility of witnesses. The engineer-expert is thereby subject to questioning throughout a very wide range of engineering and scientific theory and practice. However, the scope of questioning is not necessarily beyond the realm of reasonable anticipation and preparation for those experienced in trial procedure.

For example, if the litigation relates to the burning down of an industrial building due to a short circuit in its wiring, questioning can be expected during direct examination regarding fuse ratings, circuits, and the transformer at the service entrance. But on cross examination, the engineer-expert may be asked to calculate the oil temperature rise in the transformer during the transient period under short circuit. Or, the expert might be asked about the transformer's protection against lightning. Indeed, he may be questioned about transient disturbances on the high-voltage lines that supplied power to the transformer.

The significant point is that an alert, experienced

expert should anticipate such questions. The transformer here was an important electrical device through which abnormally large fault current was delivered to the short circuit in the plant wiring. It might seem far-fetched to conceive and propound questions during cross examination about the electric generators located miles away that supplied power to the transformer. However, questioning on such remotely related subject matter still lies within the province of the cross examiner.

Challenging the Expert

The opposing attorney may attempt to weaken and belittle the credibility of the expert. To illustrate attacks on the expert's credibility, consider a trial relating to the collision of two vessels. The cause of the collision was held by the plaintiff to be a short circuit in wires insulated with "varnished cambric." The short circuit made the control system inoperative and the defendant's vessel could not be turned off of the course leading to the collision.

In questioning me about the condition of the control wires in the steering gear switch box, the cross-examining attorney included the term "varnished cambric" in nearly every question. It raised suspicions in my mind that the defense attorney had some ulterior motive in so doing. He made clear in his questions that I had examined the wires and the "varnished cambric" covering many times. Finally, with a long and artful build-up and using his most subtle approach, he asked, "Now, Mr. Beach, suppose I were to tell you the covering on those wires is not 'varnished cambric' at all. What would you say to that?" I replied promptly, "I would agree with you." Actually, the covering was tight-fitting cotton sleeving. This unanticipated answer deflated the attorney and destroyed his attack.

Aggressive Opposition

Aggressive attitudes in opposing counsel may be displayed as soon in the expert's testimony as the first statements of his qualifications are made. The attorney may challenge the experience of the expert. By immediate cross examination, he may try to show to the court and jury a lack in the expert of specific experience in areas of engineering or scientific practice that the counsellor considers fundamental to the case. If he can obtain admissions of limited experience from the expert, he will make much of it in an impassioned appeal to the presiding judge. In his concluding remarks, he will move for the dismissal of the expert on the grounds of incompetence. Obviously, the dismissal of the expert witness would be embarrassing not only to him but also to his attorney. This sudden turn of events might well prove disastrous.

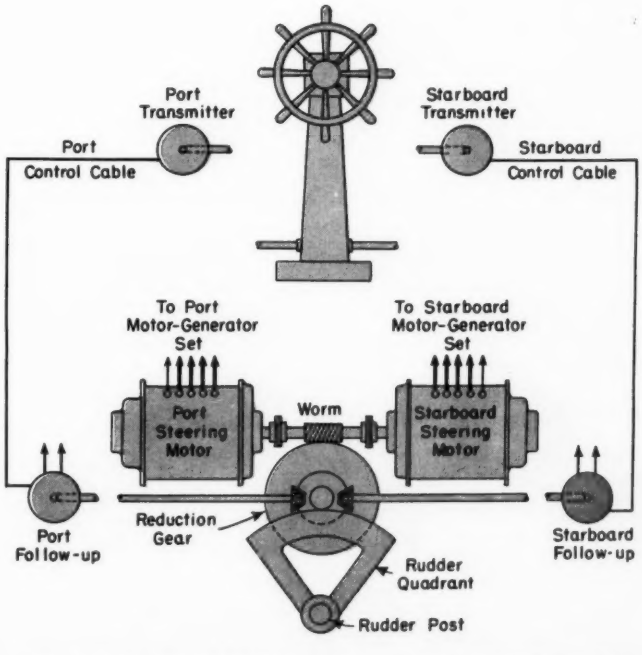
However, the challenge of an expert's qualifications by opposing counsel is a hazard that should be carefully anticipated. The most effective barrier against disqualification of the expert is established by fully elaborating on his experience as it relates to the technical aspects of the litigation. Any prospective expert entering a case should be certain that his experience, both broadly and specifically, covers the scientific and engineering fundamentals on which the case is essentially predicated. His weaknesses by virtue of inadequate experience should be conscientiously analyzed and appraised before taking the case.

War of Nerves

Some lawyers make a point of interrupting the expert witness soon after he starts testifying in direct examination. This strategy is aimed at disconcerting the expert, distracting him, and starting a war of nerves to exasperate, anger, or otherwise frustrate him as early as possible.

The expert's attorney may raise objections to such tactics on the basis of their being irrelevant, immaterial, incompetent, or otherwise out of order. The expert should listen attentively, wait for the ruling of the court, and then proceed accordingly. The court may over-rule the objection. The expert must then answer the question directed to him by opposing counsel. If the court sustains the objection, the expert continues his discourse from the point where he was interrupted and ignores the interjected question. If confused by the rapid interplay of sharp words, the expert should make certain as to how to proceed by asking the court's ruling before continuing his testimony.

If the engineer-expert feels that the force of his previous testimony has been weakened or lost because of the interruption, he should repeat the



IN CROSS EXAMINATION, TRAP FOR EXPERT WAS BAITED BY CITING CONTROL SYSTEM'S INSULATION.

latter part of his testimony for continuity as well as for emphasis. He may even appeal to the court that the interruption broke the continuity of his testimony, and that he desires to repeat it before proceeding with the remainder.

An alert expert sometimes can put an effective stop to attempted interruptions with sharp-witted, but seemingly friendly, replies whereby the opposing counsellor himself is made to appear ludicrous. To be effective, such repartee must be quick and spontaneous in its humor, arrestment, and wrist-slapping. When adroitly executed by a well-poised witness, such aggressive replies not only may put a brake on further testing of the expert, but they may also deter the opposition from cross examination at a later period. However, the witness must be cautious never to give the impression of being "smart" or insolent.

You Vs. Youse

In one bitterly contested trial, the plaintiff used four expert witnesses, three of whom were subjected to grilling cross examination that lasted for two and three days each. The fourth expert devoted about one day to direct examination. Soon after starting his testimony, opposing counsel interjected a personal question. He received a prompt, humorous, and evasive reply that caused an uproar of laughter by everyone in the court room, including judge and jury:

The expert was enthusiastically gesticulating as he stood before the jury while explaining some electrical drawings sketched on the easel. He was using such phrases as "If you do this. . ." and "If you do that. . .," when the opposing counsel arose. With impressive dignity, he addressed himself to the expert: "Sir, while you were saying 'If you do this. . .' and 'If you do that. . .,' you seemed to be looking directly at me. Did you mean me personally?" The witness answered, "Counsellor, I come from Brooklyn. If you had been listening attentively, you would have heard me say 'youse,' not 'you.' In Brooklyn parlance, that means everybody and not just you, sir."

One more attempt was made by opposing counsel to nettle the witness, with the same result. He was not interrupted again during the remaining several hours of testimony. To everyone's surprise, he was not subjected to any of the cross examination that would normally be expected to follow later.

Plaintiff's Difficulty

The expert on the plaintiff's side labors under the difficulty of not knowing until comparatively late in the trial what theory the defense will use in rebuttal. Also, the defense's expert may want to modify his theory after first hearing the initial testimony of the plaintiff's expert. The defense's expert thus holds an advantage in learning the plaintiff's theory before the plaintiff's expert learns defendant's theory.

Generally, the defendant has the comforting advantage of having the factual information at hand relating to the events on which the litigation is based. Unless the plaintiff's experts have full access to all elements in the disaster upon which to make a thorough analysis of it and its cause, they may be confronted with uncertainty in using speculative information.

Seek Court Order

To acquire many of the facts necessary for developing a strong and tenable theory, the plaintiff may have to seek a court order permitting examinations of defendant's witnesses before trial, permitting solicitation of defendant's answers to questions, and permitting on-the-site inspections. The expert generally plays a leading role in assisting the attorney in the examinations, in phrasing questions, and in making the inspections.

These actions permitted by the court are often vehemently argued by the defense attorneys. If such arguments are permitted to restrict the plaintiff's investigations, they may render the plaintiff's facts incomplete and unsatisfactory. However, taking the witness stand while being uncertain of salient facts can reflect adversely by lack of confidence in giving direct testimony and in cross examination.

Sometimes, cross examination is made hazardous by the participation of many attorneys who represent related interests in the litigation. They may operate in relays during cross examination. What bedevilment one of them does not think of, the others are sure to dream up while sitting back and listening to their colleagues.

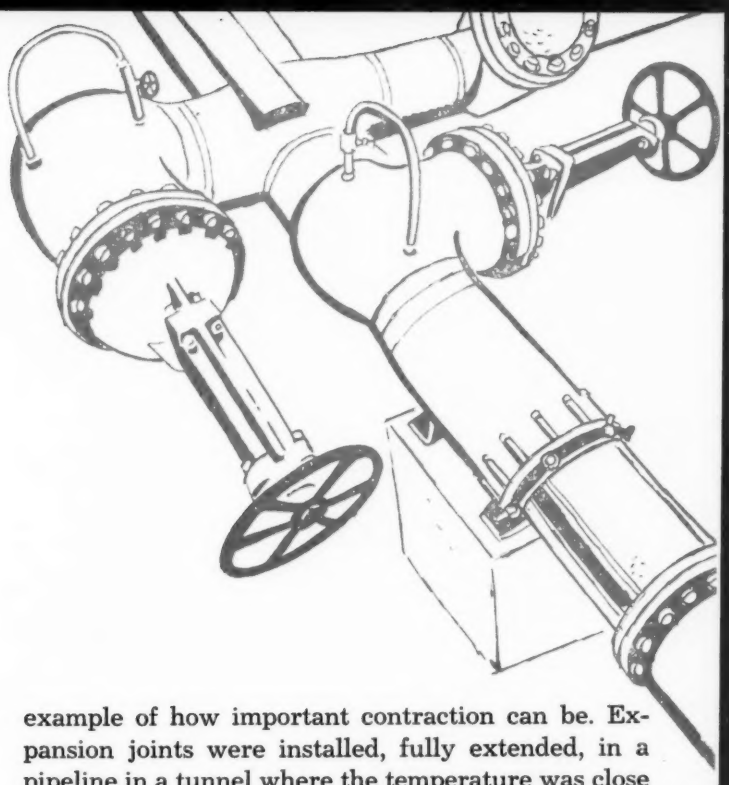
Sources of Experience

A time-consuming method of becoming better acquainted with the problems confronting an engineer-expert is to attend court sessions and to listen to experts' testimony. But unless an experienced trial lawyer were present to point out significant details, little may be gained by the inexperienced observer.

Another method of learning the problems of expert witnesses in action is to study court records of trials. Here also, unless the virtues and errors apparent in the cold words of the records are explained by an experienced trial lawyer, important information may well escape the attention of the uninitiated. Such trial records are available in law libraries. Any lawyer could advise where and how to find these trial records.

The literature is almost barren of information that would be directly helpful to initiates about to serve in the role of expert witness. Experience is the only qualified teacher. ▲▲

Design Data For Expansion Joints



P. R. LUTZ, Mechanical Engineer
Day & Zimmermann, Inc.

and

K. S. Roberts, Mechanical Engineer
Yarnall-Waring Company

EXPANSION JOINTS, when properly designed and installed, are effective and reliable devices for absorbing stresses in pipelines. However, even after the various types available have been studied carefully and the joint that meets the specific requirements most satisfactorily has been chosen, it is equally important to insure their best performance by observing a few simple but vital precautions when designing the installation.

Traverse

In determining the amount of traverse, figure the expansion of the pipe over its full temperature range. The lowest temperature that will be encountered is just as important as the maximum temperature. This means that if the expansion tables available start at 70 F (as some of them do) and the line is to be installed outdoors where winter temperatures can drop as low as 20 F below zero, traverse must be provided to cover the additional 90 F range below the reference temperature of 70 F.

Presetting

Where traverse in both directions is expected, it is essential, when actually placing the joint, to preset it for the temperature of the pipe at the time of installation. With slip-type joints, the sleeve should be pushed in from its fully extended position a distance equal to or slightly greater than the distance the pipe will contract in going from the installation temperature down to the minimum temperature. For the example cited above, if the installation temperature is 70 F, the sleeve should be preset enough to accommodate 90 F of contraction — or approximately one inch if the pipe is 100-ft long. Bellows joints are sometimes furnished in mid-position (halfway between the fully compressed and fully extended positions of the unit) to cover such conditions, but with all designs the manufacturer's installation instructions should be followed carefully.

An incident reported not very long ago is a perfect example of how important contraction can be. Expansion joints were installed, fully extended, in a pipeline in a tunnel where the temperature was close to 100 F. The line was well supported and rigidly anchored to the tunnel wall with through bolts and backing plates. In accordance with good practice, the system was given a hydrostatic pressure test prior to putting it into steam service. However, the hydrostatic test water came from a deep well at a temperature between 40 and 50 F, and the pipe contracted with unfortunate results. The pipe anchors were literally pulled away from the wall. Obviously, the trouble in this case was not that the anchors were inadequate but that no provision had been made for contraction of the pipe.

Expansion

The curve in Fig. 1 gives the expansion of steel pipe for any temperature range up to 700 F. For convenience, one scale also provides the saturation temperatures for various steam pressures. Given the temperature range and pipe length involved, the total traverse and amount of presetting can be readily determined. It should be noted that when the minimum temperature is below 0 F, the temperature range used in determining expansion must be increased accordingly. Values taken from the curve include a safety factor of 10 percent over the actual pipe expansion to provide for discrepancies in installation and unforeseen temperature extremes.

Anchors

Anchors are important in any piping system, but there are some special considerations necessary when expansion joints are used. In general, anchors are installed to stabilize the piping at certain vital points, such as valves or other equipment, junctions of two or more pipes, and terminal points. With expansion joints, anchors also serve to divide the system into sections, so that each joint absorbs only the expansion in its own section. This may

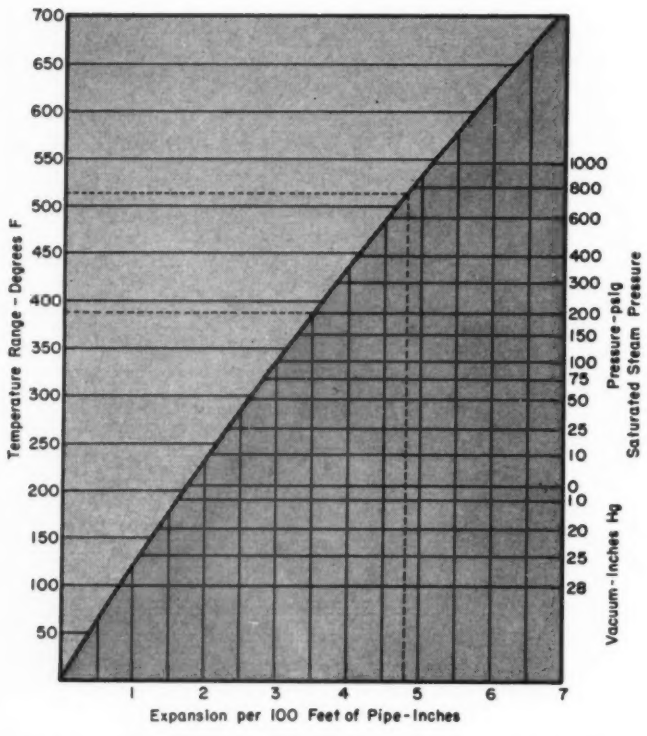


FIG. 1—EXPANSION OF STEEL PIPE VS TEMPERATURE.

seem elementary, but it is frequently overlooked. There are numerous instances where two joints are installed in the same section without intermediate anchors with the result that one joint becomes overloaded and subject to damage while the other one is underloaded. The converse of this is that two anchors should never be placed in a straight run of pipe without an expansion joint or other device to absorb the expansion between them.

Anchor design is particularly important with high pressures and large pipe sizes because of the high thrusts that develop at end anchors. End anchors are so-called because they occur at terminal points and at changes in direction of the pipe. At these points, the pressure acting on the inside area of the pipe would tend, if unrestrained by anchors, to pull an expansion joint apart. Thus, end anchors must absorb this pressure reaction as well as the forces required to activate the expansion joint and to overcome friction in supports and guides. Intermediate anchors, on the other hand, are subject to only the latter forces. The curves in Fig. 2 illustrate the comparative magnitude of end and intermediate anchor loads for slip-type expansion joints, and they also provide reasonably accurate anchor load figures for various pipe sizes and pressures.

Occasionally installations have been observed where an expansion joint was anchored by only one of its two legs or by an inadequate number of anchor bolts. While this can be done safely under certain favorable conditions, it is not generally recommended. Such procedures have resulted in damage to the expansion joint or to the piping, either from the excessive loading on the secured leg or from the inadequate number of anchor bolts. Trouble of this sort is not the fault of the joint, but of the manner of installation. As a rule an expansion joint, like any other fitting, should be anchored with the full number of bolts provided for in the base.

Bending moments caused by offsets in the piping are another source of trouble. Offsets are often necessary to get around obstacles in the line of the pipe, or to shift its axis a few feet up or down or sideways. The net effect is to create a bending moment on the pipe and elbows that is proportional to the thrusts at the elbows and to the length of the offset. If the expansion in the offset leg is relatively small, an additional expansion joint may not be required, and diagonal bracing of the elbows to provide rigidity may suffice. However, every project must be checked carefully because frequently it is necessary to anchor both elbows to prevent excessive bending stresses in the pipe.

Results at one offset installation provide a graphic illustration of the effect of bending moments. A 16-in. steam line in a tunnel had a right-angle offset of 16 feet. One elbow was connected to the body of the slip-type expansion joint, which had an extremely rugged double anchor. The other elbow was only lightly braced by an I-beam that was not properly aligned with the run of the pipe. This brace was not strong enough to withstand the end anchor loads bearing on it, and it eventually collapsed. With the full end thrust then acting on the offset, a very

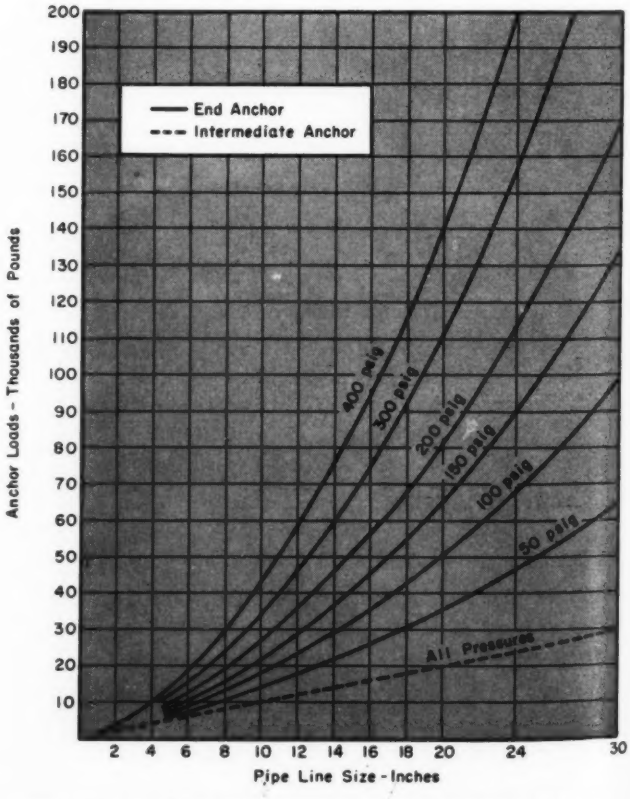


FIG. 2—SLIP-TYPE EXPANSION JOINT ANCHOR LOADS.

large moment was created at the other elbow and the adjacent anchored joint.

Although the joint anchorage was more than adequate for its normal loading, it could not withstand this additional stress. All the anchor bolts were either sheared or dislodged from their concrete foundations and, were it not for its limit stops, the expansion joint probably would have separated. This demonstrates not only the force of a moment at an offset, but also the effect of a failure in one part of a system on other parts. The expansion joint, because of its rugged construction, withstood the abnormally high stresses impressed upon it and prevented further damage to the system.

Alignment

Expansion joints, regardless of type, require good pipe alignment to perform satisfactorily. While many installations function well without alignment guides, numerous reports of serious trouble and occasionally of failure are attributable to the absence of alignment guides.

Guides serve two important purposes. First, when installed near an expansion joint, they hold the pipe in the proper position for best operation of the joint. With slip-type joints, this prevents cocking of the sleeve in the joint — a condition that could cause excessive friction. In bellows-type joints, it prevents the excessive stresses on the bellows that develop with lateral and angular misalignment of the pipe.

Second, they prevent buckling of long spans of pipe when subjected to compressive loads as they expand. Pipe spans are similar to structural columns in this respect, and with both the tendency to buckle under a fixed load is measured in terms of slenderness ratio (ratio of length to radius of gyration). Simply stated, this means that the tendency to buckle increases as the pipe becomes smaller in diameter, longer, or both, so the need for guides is greatest with long spans and relatively small pipes.

A 3-in. steam line was installed with slip joints in spans several hundred feet in length. No guides were installed. When steam was turned on and the pipe began to expand, the pipe bowed, and the joint sleeves did not budge. The compressive load on the pipe was enough, when combined with a very high slenderness ratio, to cause the pipe to bow laterally as it expanded. The resulting misalignment of the pipe created additional friction in the slip joints and thus progressively aggravated the condition that initiated the bowing. This situation was completely corrected at very little expense by the installation of a few simple alignment guides.

Recommended spacings of alignment guides from expansion joints and also between guides for various nominal pipe sizes are shown in Table 1. These values insure safe slenderness ratios in long spans. Note that externally guided slip joints permit a greater distance between joint and nearest guide. It should be pointed out that alignment guides are equally important in bellows joint installations, to prevent damage to the joint or the system.

Supports

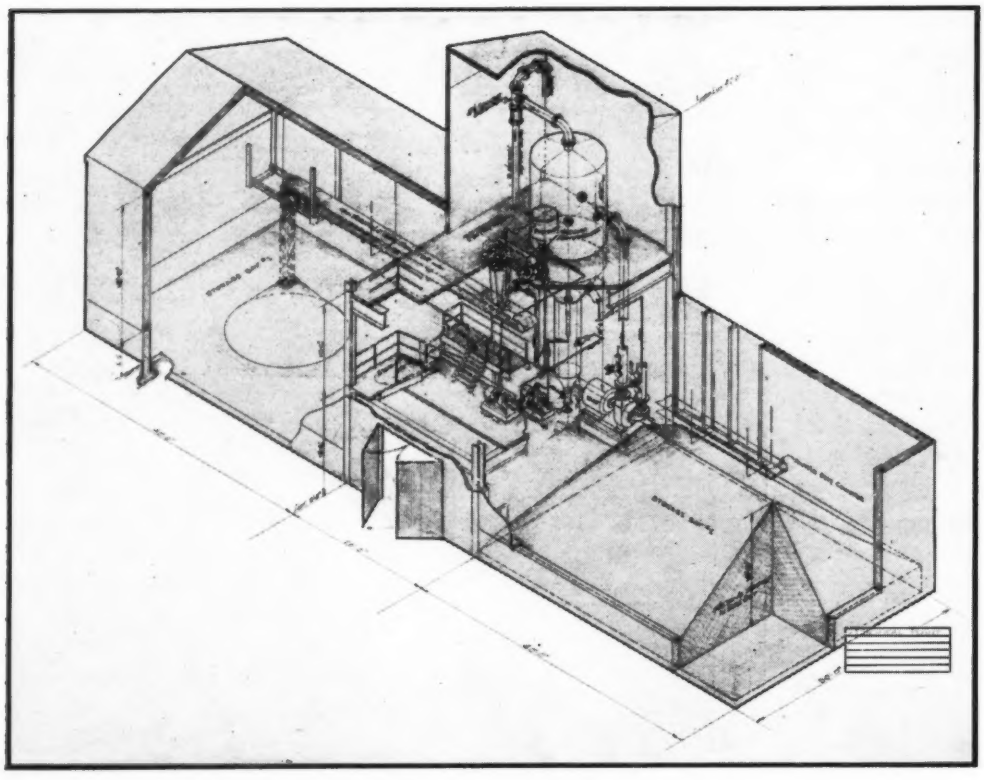
Table 1 also provides generally recommended spacing of supports for steel pipe filled with water. Since the importance of adequate support is well recognized, expansion joint difficulties are very seldom traceable to poor supports. One rather unusual occurrence, however, is worth mentioning. A long 24-in. steam line installed in a tunnel was supported on horizontal I-beams which were supported by a steel channel column on one side and the wall of the tunnel on the other side. Rollers were bolted to the tops of the I-beams to permit motion of the pipe as it expanded and contracted.

After a relatively short time in service, it was noticed that a number of the I-beams were being distorted laterally and were in danger of failing under the weight of the pipe. When the design of the supports was checked, it was discovered that the I-beams were heavy enough to support the vertical load of the pipe and its contents, but they were not heavy enough to take this load plus the traverse thrust applied by the pipe as it moved over the rollers. The solution at this project was either to use heavier I-beams (greater section modulus) or to brace the existing beams against lateral thrusts in some way. Expansion joints had no connection with this situation since motion of the pipe must take place regardless of how it is accommodated.

While these precautionary suggestions may prove helpful in designing expansion joint installations, occasionally problems arise that are somewhat more complicated. In such instances, expansion joint manufacturers are more than willing to offer assistance based on their knowledge and experience in the piping field. ▲▲

TABLE 1—RECOMMENDED SPACING FOR PIPE ALIGNMENT GUIDES AND SUPPORTS, IN FEET

Nominal pipe size, inches	1½	2	2½	3	3½	4	5	6	8	10	12	14	16	18	20	24
Distance between guide and expansion joint																
For internally guided joints	5	5	6	6	7	7	8	8	9	9	10	10	11	11	12	12
For internally-externally guided joints	8	10	11	12	13	14	15	16	18	20	21	22	23	24	25	26
Distance between alignment guides	10	13	15	19	22	25	30	35	45	60	70	80	90	100	105	110
Maximum distance between pipe supports	8	10	11	12	13	14	15	16	18	20	21	22	23	24	25	26



THIS ISOMETRIC DRAWING OF A SMALL CHEMICAL PLANT (DONE IN PENCIL) TOOK 16 HOURS DRAFTING TIME UNDER SUPERVISION OF A CHEMICAL ENGINEER.

New Techniques Cut Drafting Costs

H. J. REINIG, Mechanical Design Engineer, Singmaster & Breyer

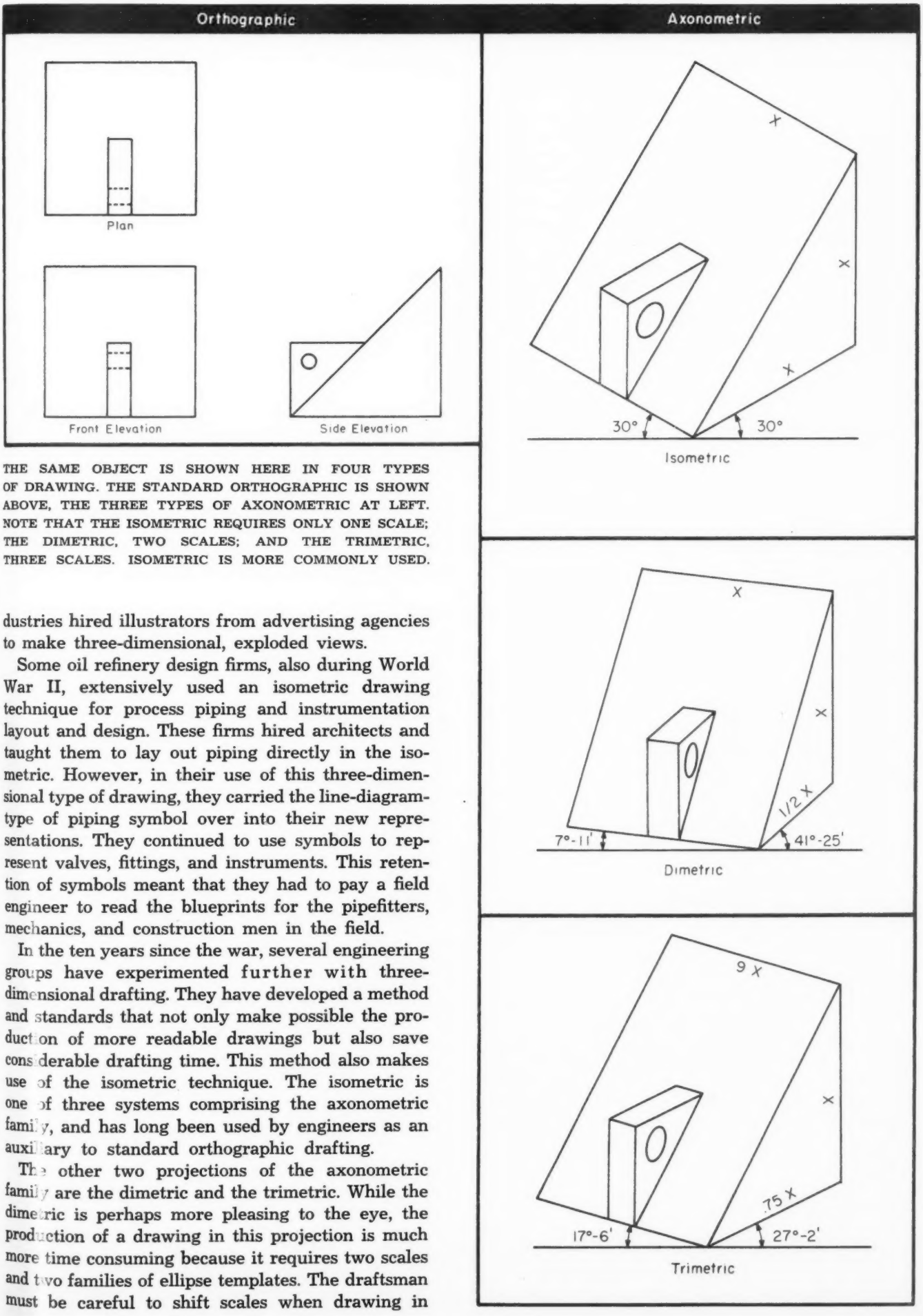
Henry J. Reinig is currently the Chief Mechanical Engineer in charge of Mechanical Design Department on Chemical Feed Plant Projects for Singmaster & Breyer. His first job, in 1938, was as a draftsman with a pressure vessel fabricating plant. During the past 17 years he has worked in the field of mechanical design with such companies as M. W. Kellogg and Carbide and Carbon Chemical. He is the inventor of a bellows body valve for vacuum and chemical service and several automatic robots for metal smelting furnaces. These robots were developed while working with the Atomic Energy Commission.

CE exclusive

IT HAS TAKEN more than ten years for engineers to prove to themselves and their clients the value of three-dimensional scale models. Today, few will deny their usefulness as design, construction, and operating tools. However, the scale model cannot substitute entirely for the blueprint. Certain drawings and studies have to be made as basic instructions to the constructor and to the mechanical and electrical trades.

With all the progress made in engineering during the past few years, the same techniques of drafting are generally used that were common practice at the turn of the century.

An important advance in drafting techniques was forced upon us in the aircraft, chemical, and atomic energy industries during the last war. The need for improved drafting methods became obvious then as soon as great numbers of semi-skilled and hurriedly trained employees were hired on highly technical jobs. Even the physicists and chemists of the atomic bomb project were incapable of quickly understanding drawings made by their design engineers. Many of these war-inflated in-



THE SAME OBJECT IS SHOWN HERE IN FOUR TYPES OF DRAWING. THE STANDARD ORTHOGRAPHIC IS SHOWN ABOVE, THE THREE TYPES OF AXONOMETRIC AT LEFT. NOTE THAT THE ISOMETRIC REQUIRES ONLY ONE SCALE; THE DIMETRIC, TWO SCALES; AND THE TRIMETRIC, THREE SCALES. ISOMETRIC IS MORE COMMONLY USED.

dustries hired illustrators from advertising agencies to make three-dimensional, exploded views.

Some oil refinery design firms, also during World War II, extensively used an isometric drawing technique for process piping and instrumentation layout and design. These firms hired architects and taught them to lay out piping directly in the isometric. However, in their use of this three-dimensional type of drawing, they carried the line-diagram-type of piping symbol over into their new representations. They continued to use symbols to represent valves, fittings, and instruments. This retention of symbols meant that they had to pay a field engineer to read the blueprints for the pipefitters, mechanics, and construction men in the field.

In the ten years since the war, several engineering groups have experimented further with three-dimensional drafting. They have developed a method and standards that not only make possible the production of more readable drawings but also save considerable drafting time. This method also makes use of the isometric technique. The isometric is one of three systems comprising the axonometric family, and has long been used by engineers as an auxiliary to standard orthographic drafting.

The other two projections of the axonometric family are the dimetric and the trimetric. While the dimetric is perhaps more pleasing to the eye, the production of a drawing in this projection is much more time consuming because it requires two scales and two families of ellipse templates. The draftsman must be careful to shift scales when drawing in

different planes. The trimetric requires three scales and three sets of ellipses. It is by far the most time consuming for the draftsman and would be worth the extra effort only on certain complicated machine design work.

The isometric was singled out of the axonometric group because its three basic planes are at the same angle to the viewer's eye. Therefore, only one scale is necessary for measuring in all three planes. The isometric drawing is something of a compromise between the conventional orthographic drawing and the true perspective rendering. Many engineers have avoided its use only because they were under the misconception that an orthographic drawing had to be made before starting on the isometric. This stems from their school days when they were taught drawing by projection rather than by visualization of the object. Most of the text books teach

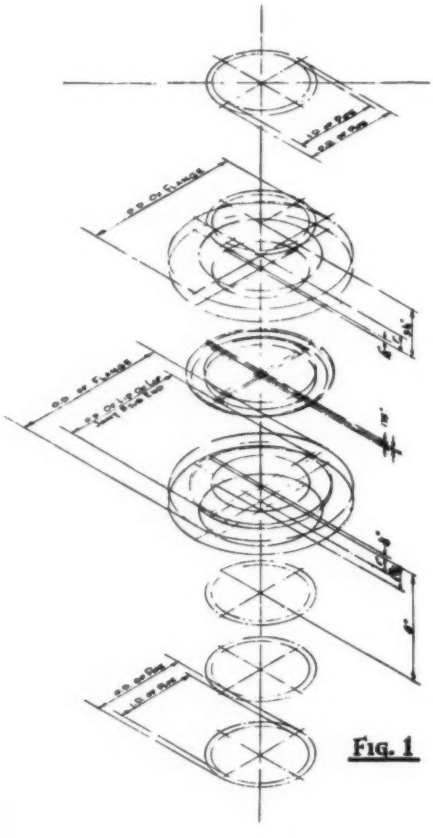


Fig. 1

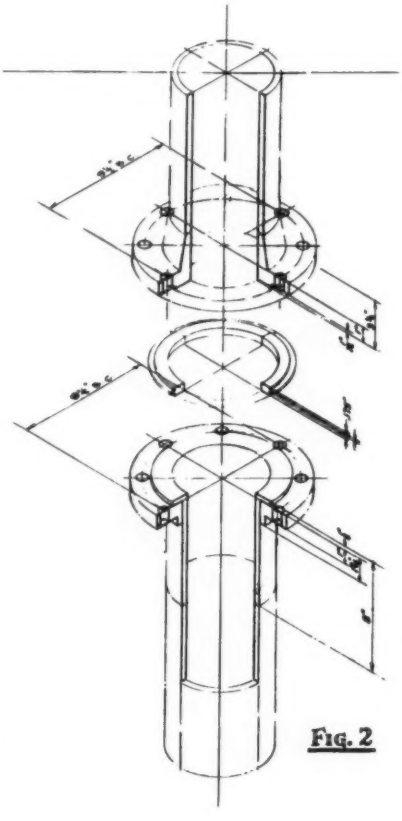


Fig. 2

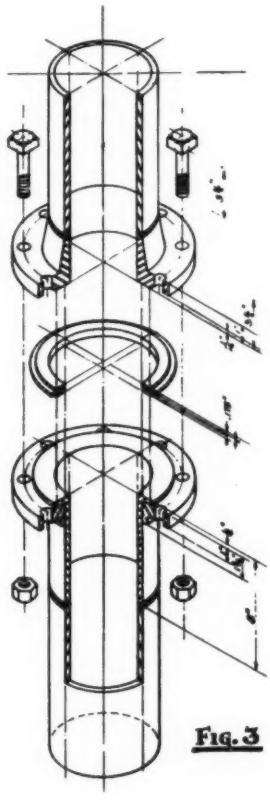


Fig. 3

PROBLEM

Make a Mechanical Isometric Drawing of an exploded quarter section of a 6 in. 150 lb A.S.A. flange joint, to scale.

One flange is to be a 6 in. 150 lb forged steel welding neck flange welded to schedule 40 steel pipe.

Other flange to be a 6 in. 150 lb forged steel lap joint flange with seamless steel standard weight lap joint stub end conventionally welded to schedule 40 steel pipe.

Gasket to be spiral wound type with centering ring.

Bolting to be standard square head bolts with hex nuts.

PROCEDURE

Do not attempt to develop this problem without a set of ellipses guides, or you will strangle your drawing in construction lines.

FIGURE 1

1. Draw center line of pipe.
2. Scale dimensions on this center line.
3. Draw isometric axis lightly through dimension points.
4. On isometric axis, scale important diameters of flanges and gasket such as:
   - O.D. of Flanges and Pipe
   - I.D. of Flanges and Pipe
   - O.D. of Lip on Lap Joint Stub End
   - I.D. and O.D. of Gasket
5. Use isometric ellipse guides and draw ellipses lightly. Note positioning of dimensions on the drawing.

FIGURE 2

6. Pick out points where isometric axes intersect ellipses and draw lines forming cross section of flange.
7. Scale BC on isometric axis on each flange and draw ellipses lightly.
8. A 6-in. flange has eight bolt holes, therefore, it is an easy matter to spot their center points on the BC's. These eight center points fall on the normal 90° axes and the 45° axes.
9. Draw light center lines through these center points perpendicular to the plane of the BC, and then draw bolt holes with ellipse guide.

FIGURE 3

10. Draw out center lines of certain bolt holes and scale bolt and nut dimensions.
11. Construct isometric axes as was done in Fig. 1, for development of the flanges.
12. Draw light ellipse to represent planes of bolt head and nut.
13. Draw in bolt and nut.
14. If you have reached this step you are capable of completing the drawing.

To construct this drawing should take a maximum of three hours, once a draftsman learns the isometric.

isometric drawing by projection from a plan view, side view, and sections. This is the wrong approach. It is not suited to the needs of the design engineer, and it is entirely unnecessary. Using the new technique of "thinking in the isometric," the three-dimensional views are drawn without the need of any projections from a preliminary orthographic study.

It is also true that just a few years ago the scaled mechanical three-dimensional drawing was next to impossible for the hurried draftsman because most designs include circles and curves of various diameters. The minimum of eight construction lines necessary to determine a circle in the axonometric technique strangled the designer and draftsman with construction lines. Today, with ellipse templates being common drafting tools, it takes only two guide lines to draw a circle in its proper size and position on a three-dimensional drawing.

Compare the illustrated orthographic study and the isometric study of the piping at a condenser station. Not only is the isometric much easier to read, but it required only 12 hours of development as opposed to 16 hours for the orthographic view.

Experience in one of the leading architect-engineering firms in New York City has proved that, on the design of over $50 million worth of new chemical plants, a saving of better than 50 percent of the cost of piping design is realized when done in isometric as compared to the cost of doing the same work in the orthographic. This design work involved six different chemical plants. One of these plants was done in the isometric by designers and draftsmen who had only a vague idea of isometric theory.

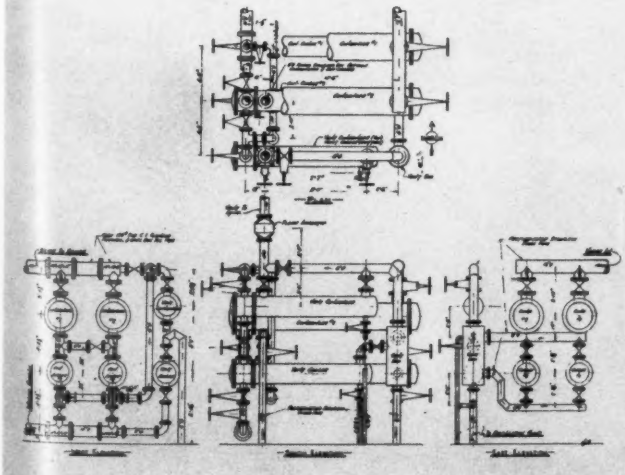
Before attempting to have these men do the piping layout, four three-hour lectures on theory of the isometric were given them. As a result of this training course, it was estimated that at least 80 percent of the designers and draftsmen now working in the engineering field can master the theory of isometric so as to make it much the most economical drawing method for plant layout, materials handling layout, process and power piping layout, and instrumentation layout.

Machine design work in the isometric is much more complicated. Perhaps only one-third of the machine designers and draftsmen in this field would be able to master the technique because of the scale precision required.

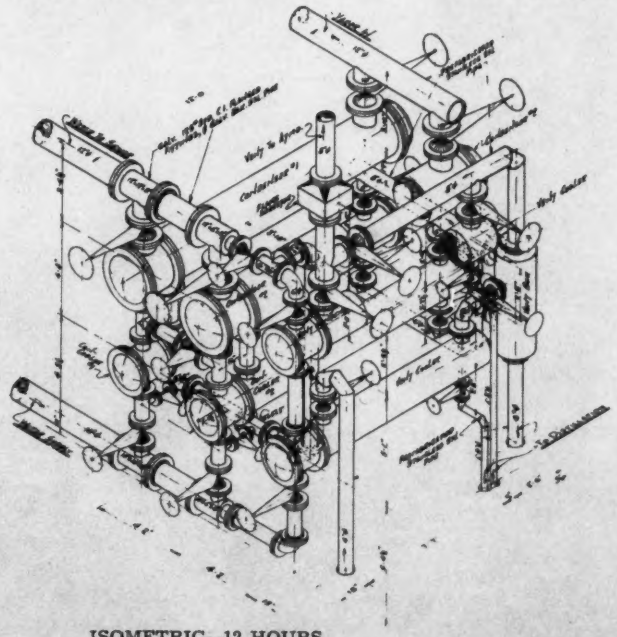
Not only does the three-dimensional drafting technique prove a money saver within the engineering office, but it has been found that these savings are only a fraction of those brought about in the field during construction. Even a layman can read isometric drawings. Therefore, the pipefitter, mechanic, and constructor have no trouble in interpreting them. It was found in certain AEC chemical plants that isometric piping details and assembly drawings paid for themselves several times over in construction cost savings. Recognizing this, the engineers had all piping layout redrawn in the isometric.

There is little doubt but that three-dimensional drafting techniques will be adopted by more and more engineering offices in the future. On the other hand it must be remembered that as the scale model does not completely replace the need for blueprints, neither will the isometric substitute in all instances for the orthographic. ▲ ▲

CONDENSER STATION



ORTHOGRAPHIC—16 HOURS



ISOMETRIC—12 HOURS

New Ideas For Warehouse Design

CE exclusive

WILLIAM H. MESEROLE
Ballinger-Meserole Co.
Warehouse Consultants
Philadelphia, Penna.

William H. Meserole is president of Ballinger-Meserole Company, industrial and distributive space and methods consultants, in Philadelphia.

He was educated in the National Academy of Design, 1911-14, and Societe' des Beau Arts, 1914-17 (Medallist, 2nd Class, 1917).

He enlisted in the U. S. Army during the First World War, and joined the American Relief Administration in 1918, serving as a statistician until 1925, then as an economist until 1928. He joined the Marketing and Distribution Division of the U. S. Department of Commerce in 1928, where he served until 1945.

He moved into private business that year, joining Ballinger Associates of Philadelphia, as chief engineer. He became president of the only industrial consulting firm in the country specializing exclusively in wholesale distribution warehouses when the Ballinger-Meserole Company was organized in 1952.

A WHOLESALE distribution warehouse is more than just a belly for merchandise. Many services must be performed with the goods besides static storage and protection. Any warehouse used for distribution purposes, food or non-food, must be large enough to:

¶ Hold the inventory load, consisting of so many pounds, pieces, or dollars' worth of merchandise arrayed in some pattern and stacked to some height.

¶ Provide access to every different item of goods for order-picking by having sufficient aisle length to show a given number of merchandise "fronts" from which goods are selected.

It is that simple. Now, anyone can tell how much warehouse he needs because the data are all readily available. But how to bring about a happy, low-cost arrangement of space is not so easy.

There are some techniques for cutting costs in distribution warehouses. That is all you can do—cut costs. No matter how you look at it, the warehouse will always be an overhead expense item. Obviously, it will never make money. The most you can do is make it so efficient that you save on overhead. These techniques have been developed during years of experiences in designing functional warehouses and

making them operate at peak efficiency. The methods have worked well for our clients. So well, in fact, that we have cut some warehouse overheads from 4 and 5 percent to less than 1 percent of sales. Some of these warehouses are actually shipping $1 million a year per person on the warehouse payroll.

The seven steps are:

1. At least 70 percent of the usable building volume and every possible square foot of floor area should be utilized.
2. At least 20 feet of vertical storage space between floor slab and roof trusses should be allowed in a single-story building—the optimum structure.
3. Power lift and hauling machines should be used wherever practical.
4. Standard small pallets should be used wherever possible.
5. Order-pick lines should be employed.
6. Merchandise should be stored on the line according to its cost-making characteristics of bulk, weight, and velocity of movement.
7. A slot system should be introduced, usually in conjunction with punched card tabulating machines, for controlling flow and determining inventory.

Cubage and Footage

The first principle—optimum use of cubage and footage—may seem obvious, but viewed in the perspective of ever-rising building costs, it takes on new meaning. Good warehouses were built in the 1930's for $1.50 per square foot. They rented for about 15 cents per square foot per year. By 1940, costs had leaped to $2.50. Rents had doubled. In 1950, we acted as consultants on the design and engineering of a low-cost warehouse in Philadelphia, at $4.60 psf, renting for about 50 cents psf. Now $6.50 or $7.00 psf and 65 cents to $1.00 rentals are not considered exhorbitant.

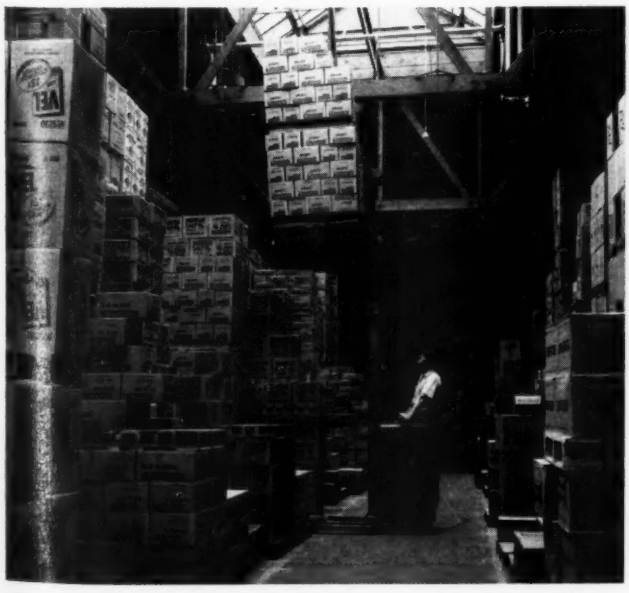
This inflationary trend can be counteracted only by (1) stretching building materials to produce more space for the same money, and (2) inaugurating operating plans that make this space work harder and better.

Maximum use of cubage and footage reduces labor costs as well as occupancy costs per unit of goods shipped. Handling cost per unit is cut if space and operations are planned to get more done per man hour. From an operation standpoint this means shortening the haul from receiving to storage to order-pick location and tailgates. It means using "high cubage" with reserve stock stacked high overhead at the point of future selection so it does not have to be hauled from some other storage area. In this way other storage spaces are kept free for large contract purchases or bulky goods; the selection line can be restuffed faster; complicated storage-location records no longer are needed. Using maximum cubage and footage also cuts clerical costs.

High Ceilings

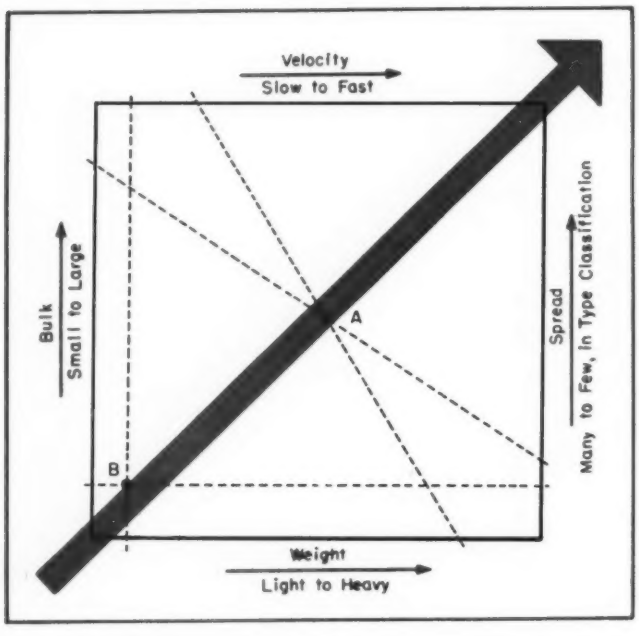
Imagine a $6.00 psf building with a clear height of 15 feet from floor slab to trusses. Each cubic foot costs 40 cents. Now picture a building with a ceiling just five feet higher, making a clear height of 20 feet. Each cubic foot now costs only 30 cents! The extra five feet of wall adds little to the total cost of the structure at the time the warehouse is built. But that negligible difference between 15 and 20 feet adds 35 percent to the inventory capacity!

In a food warehouse, the over-all height of a double-deck rack is 8 ft 5 in. (101 in.). If three pallets of No. 2 goods are stacked on the top level, 233 in. or 19 ft, 5



HIGH CEILING WAREHOUSES WITH NARROW AISLES MAKE BEST POSSIBLE USE OF AVAILABLE CUBAGE.

GOOD WAREHOUSE DESIGN USING A NUMBERED SELECTION LINE, MAKES IT EASY FOR THE ORDER PICKER.



WHAT ITEMS GO WHERE IN A WAREHOUSE

Blue arrow shows direction of flow of goods through the warehouse. To determine proper position of any item, draw a pair of lines, one from top to bottom, one from right to left, indicative of the item's characteristics. The intersection of these lines will indicate the proper location of the item in the warehouse for minimum handling costs.

in., is reached, allowing a 7-in. working clearance under truss, girder, or beam, which itself is probably 24-in. thick. Gross clearance for insurance or fire department regulation purposes is well over the required 18 in.

Bear in mind that when you measure the capacity of a warehouse you will find it can be loaded only to about 30 percent of its total maximum cubage because so many aisles are needed to get at the goods. It works like this. About half the floor space can be converted into stacks, and of the stack cubage, about 75 percent can be filled with goods. The rest of the space is pallet cubage and clearance between and over the loads. When using racks, which require even more clearances, this 75 percent may be reduced to about 60 percent—and 60 percent of 50 percent is 30 percent. Even that figure is only theoretically possible. No operator can work at a "full-use" rate. The best he can use is about 70 percent of the maximum.

Cubage Cheaper

It is almost always cheaper to build cubage than footage. Added height may not be needed at the time of building, but by providing for it at a slight extra expense, the inevitable date of expansion can be postponed. If plans call for rapid growth, adequate footage and cubage must be provided from the start.

Two other advantages of high ceilings should be noted. If the amount of available land is limited, and the firm cannot expand laterally, higher ceilings facilitate vertical expansion. Finally, extra height means other industries can use the building, making it easier to sell or mortgage when outgrown.

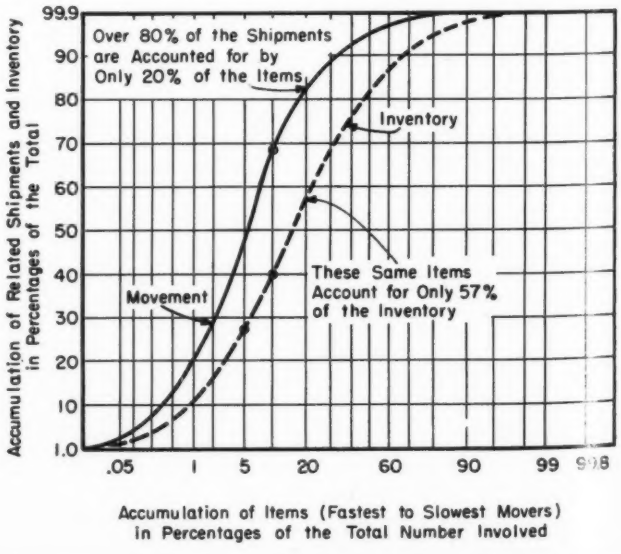
Utmost Mechanization

Back in the old days, 20 or 30 years ago, we had warehouse machines and a unit-load practice. But by today's standards they look like ox carts. The early lift-trucks needed far too much aisle space in which to maneuver—as much as 14 feet to stack a load 40 inches long. Some still do.

Now we have brought the machines down to a space-consuming limit below which we need not strive to go. We can now stack any ton of goods up to the 20 foot level, working at right angles in an aisle not more than six feet wide. This can be done with the new straddle trucks. The counter-weighted fork-lift trucks still need a 10 foot aisle or more to do the same job. We have been learning how to use the cubage, which costs less than footage. The bucket-brigade operation can be discarded, and all available cubage used if machines elevate the goods to the maximum useful height.

Straddle trucks, pallet jacks, and other unit-load machines cut the number of piece-by-piece handlings in half. If movement is all manual, each case must be handled six times: from arriving vehicle to warehouse cart . . . to storage stack . . . to cart . . . to selection stack . . . to cart . . . and into outbound vehicle. But when goods are palletized, the case is handled three times: when the pallet load is formed . . . when it is broken down for order-picking . . . and when it is loaded into the outbound truck. All intermediate movements are by machines.

Machines speed up operation. Since case handlings are reduced, the same labor force working the same hours handles more tonnage, and the individual la-



OF ALL ITEMS IN THIS WAREHOUSE, THE FASTEST MOVERS ACCOUNT FOR A VERY HIGH PROPORTION OF PALLETS SHIPPED. THIS IS FOR GROCERY WAREHOUSE.

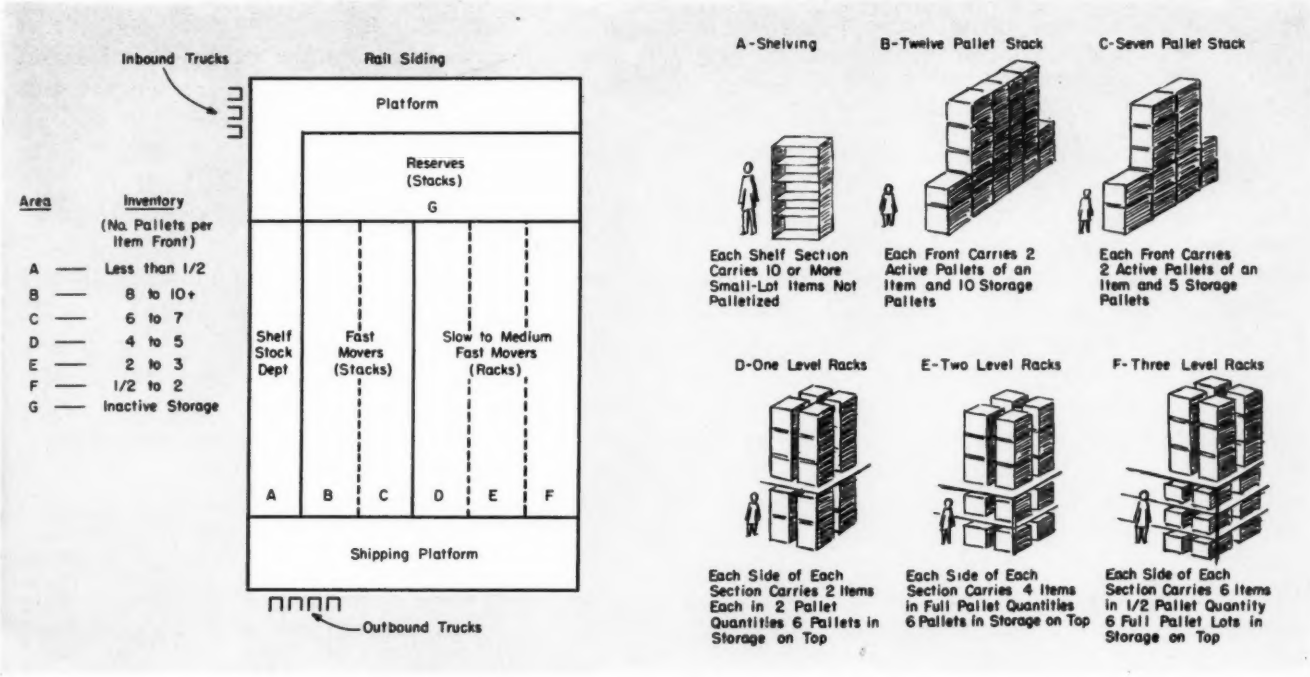


DIAGRAM AT LEFT REPRESENTS LAYOUT OF A GROCERY WAREHOUSE. EACH BEHAVIOR GROUP IS PLACED FOR MAXIMUM HANDLING ECONOMY. AT RIGHT IS SHOWN THE KINDS AND CAPACITIES OF SLOTS, THE LETTER DESIGNATIONS INDICATING THE SLOT TO BE USED IN THE SIMILARLY LETTERED AREAS IN THE DIAGRAM AT LEFT.

borer can earn more pay. Cost per ton is cut. With mechanical pallet jacks, trucks can be loaded and unloaded in 20 minutes. Railroad cars are unloaded and the merchandise stored in an hour and a half. The order-pick line is quickly restuffed, and small left-overs from originally large lots can be relocated to clear areas for new large lots.

Standard Small Pallets

We made a study recently of the movement and inventory quantities of each item carried by a large chainstore warehouse shipping 2,500 tons a week. This warehouse was equipped with 48x40-in. pallets. Aside from shelf stock and broken-package goods, the firm handled more than 600 items of which it never stocked as much as a pallet load per item at any one time. So it was necessary to hand-pile these items, two to a pallet load, each time they were received—a costly and arduous task. Here was a situation (and there are many more like it) where small pallets would have solved the problem.

The small pallet, up to 36-in. wide by 40-in. long, lets much more of the inventory spread be palletized. An average of 25 cases per pallet is the load, whereas the average is 40 cases for the larger pallets. Also, a small pallet reduces the aisle width necessary for easy operation. If the pallet is shortened six inches, six inches less aisle space is needed, and that much more space can be used for storage.

Further, the small pallets, increase the number of fronts in a given length of aisle because they are narrower than they are long. This makes a shorter inventory spread and the order-picker can pass more items per dozen strides. The line and the walk are both shortened, with a consequent increase in order-pick rate and a decrease in labor costs.

Order-Pick Lines

If a big warehouse is necessary because a firm has a big inventory, that inventory ought to be divided into active and reserve stocks. With a great deal of merchandise of any one description, the firm will not want its order-pickers to use the footsteps and the time required every time they pick an order. Labor cost tends to rise in accordance with distance travelled and the amount of tonnage hauled to the loading dock.

Order-pickers walk miles every day, even with an order-pick line. Without one they might walk twice that, or more. A picker spends about 40 percent of his time actually selecting, loading, and marking his sheet. He spends the rest of the time moving from stop to stop. Without a selection line, the picker might spend 80 percent of his time walking and pushing between stops. A line system means more output per man-hour of order-pick time.

Some say that restuffing the line costs more than the line saves. That is a fallacy. True, if you eliminate the line, you eliminate the restuffing, making it easier for the few men who receive and store the goods with mechanical equipment. But at the same time you make it demonstrably harder for the many order-pickers who generally work by hand and on foot. Since output is what the warehouse is in busi-

ness for, the wise man never makes it hard for his order-pickers if he wants to operate economically.

Ton-Mileage

Arranging inventory in warehouses by commodity groups is an old and orderly way of working, probably as old as the trade itself. It is quite in keeping with the orderliness of mind one expects of storekeepers. To them such an arrangement has always made basic good sense. It has always been what they would call "obviously efficient."

But when we note, in warehouses, that this time-honored practice inevitably results in unnecessarily high costs, we may want to reexamine this practice. If "efficiency" takes too long and costs too much, we have a misnomer. We then must achieve efficiency in terms of dispatch and economy.

So today, instead of arranging inventories according to family groups, we organize the warehouses we design so as to attain optimum ton-mileage of operation. We locate all goods on an order-pick line in relation to their cost-making characteristics of weight, bulk, and velocity of movement.

Using a wholesale grocery warehouse as an example fast-moving items and bulky goods are placed at the end of the order-pick line, in the first group, nearest the dock. Here they do not have to be hauled so far to the delivery trucks. Bulk is a most important factor, for when the order cart is filled, it must be taken to the dock. If most of the bulky goods are stored near the dock to begin with, transporting time is shortened; fatigue factor is lowered.

Normally-active movers, from 1,000 to 2,000 items regardless of the size of the business, comprise the second group. As a rule these items would be arranged in doubledeck, order-pick racks in which not more than two, and usually just one pallet load of the item is available for order-picking at any time. Both levels are geared to the height of an undersized man. If he can reach merchandise stored on them, anyone can reach them. Over these active pallet levels are three more tiers of pallets carrying the gross load all the way up to about 20 feet, so high space is all used.

Relatively slow-movers, in the third group, are palletized or hand-stacked in half-pallet loads on three-deck racks. Here the undersized man can reach cases on the third pallet level, for order-picking.

The fourth group consists of the slowest movers, so-called shelf stock. Spices, extracts, drugs, shoe polishes, and items sold in less than case quantities. Order-pick shelving for this department is usually four or five levels high under an 8-foot top, over which small surpluses of these items are stored.

The Slot System

We have seen how goods can be arranged in a low-cost-inducing warehouse sequence, not only regarding position of the items but also regarding layout.

But how do we get the orders—or order-pick forms—arranged in this warehouse sequence? Salesmen cannot use a "cost book" based on a warehouse ton-mileage sequence. The cost book from which they do their selling has to be arranged in a commodity-group classification.

Here is how we do it.

Every item has two code numbers. One is the commodity code number and this is the sequence in which the cost book is arranged. The commodity code number corresponds to an item name. As long as the item is carried for sale, that one code number will apply. The other number is called a slot number. It stands for warehouse location. Call it an address. Just as a man can move from one home to another, so goods can be relocated in the warehouse. We may want to change the positions of some highly seasonal items—just as a man may want to go to Florida in the winter and the Catskills in the summer. Note, however, that the commodity number never changes when goods are moved to or from a seasonably-desirable slot. Only the slot number changes.

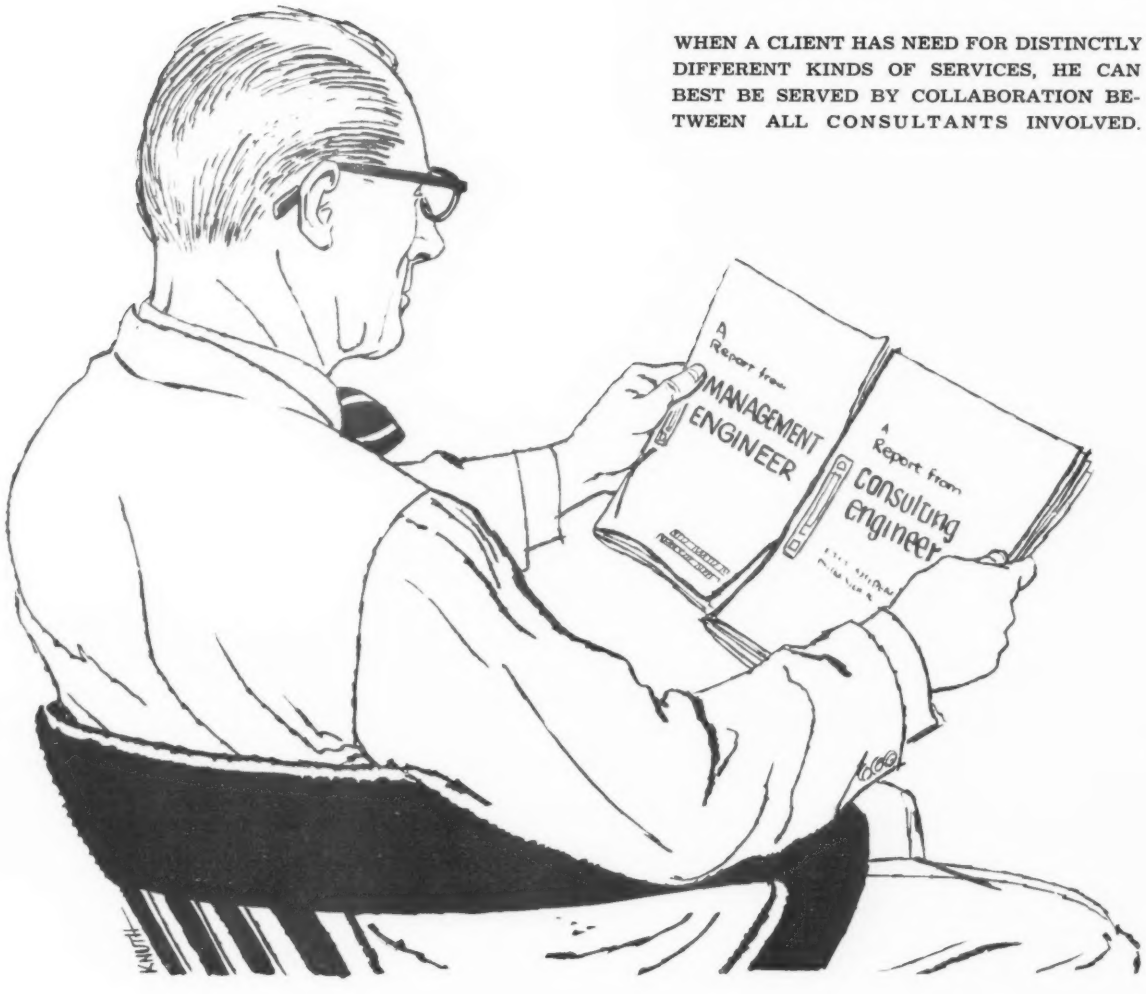
The salesman takes the order from the customer on a pre-printed order form. At the warehouse, punchcards are pulled against the goods ordered; the cards are mechanically sorted into slot number sequence, and in that sequence the invoice or order-pick form is printed on the tabulator. This governs the routing and the extent of the order-pick walk because the magnitude of the slot number is a key to the location of any item at any given time.

You might say the slot system is a bridge between the order form and the warehouse. In a sense, too, it is the integrator for many of the innovations in warehousing.

The slot number serves the order-picker as a house number serves a postman. It saves labor, does away with trial-and-error hunting and backtracking. It reduces training time for new employees, since the new picker need not be familiar with stock if he can read numbers and follow arrows painted on the floor. The line does not have to be recast periodically to make room for new items. Incoming shipments can be placed wherever suitable slots are available or can be fitted to the position and slot size that their bulk, purchase quantity, and movement justify. Cubage can be better utilized. And no slot need be held open for the arrival of any item. More space is available for use at any time.

You do not want to walk through all of the slow-movers to get to the few fast-movers called for on most orders. You do want to dodge as many of the aisles as you can on as many of the order-pick trips as possible. You want to take as few footsteps and minutes as possible in collecting and moving the order to the tailgates for shipping. You want to disperse inbound goods to their places in the order-pick line with the least movement, in the shortest time.

Only when these objectives are achieved will warehouses be totally efficient—and economical. ▲▲



WHEN A CLIENT HAS NEED FOR DISTINCTLY DIFFERENT KINDS OF SERVICES, HE CAN BEST BE SERVED BY COLLABORATION BETWEEN ALL CONSULTANTS INVOLVED.

Management Engineers - -

Ce exclusive

Competitors or Collaborators?

KENNETH J. EATON
Director
Associated Business Consultants
Management Engineers

Mr. Eaton's firm serves clients in such diverse fields as paper products, metal fabrication, plastics, foods, furniture, automotive, electronics, machine tools, cosmetics, and service industries. His services include work simplification, plant and office layout, cost systems, employee relations, profit sharing methods, and market analysis.

He is a graduate ME and IE and holds a postgraduate degree in business and economics from Illinois Institute of Technology. He is a guest lecturer on engineering economics at many colleges. Mr. Eaton is a registered professional engineer.

OF ALL THE CONSULTING engineers now practicing, probably none are more discussed or less understood than the group known as management engineers. Consultants limited to the realms of traditional engineering work should know the what, why, and how of this other, mysterious group that is called by many names — business engineers, business doctors, management consultants, consulting engineers, industrial engineers, management engineers, and (disparagingly) efficiency experts. Some carry additional titles to indicate specialized fields such as cost accountant, sales analyst, labor relations counselor, or systematizer. There just does not appear to be any generally accepted title for those of us who earn our living by engineering other people's business. At the present time, the term "consulting management engineer" probably has the highest standing.

In this field of management engineering a profes-

sion? As long as there are organizations that employ high-pressure salesmen to secure clients and who send out low-cost subordinates of questionable capacity as field engineers, management engineering (or any engineering wherein such practices exist) is not altogether a profession. Whether or not it should be strictly professional is another question.

Anyone Can Hang Shingle

There are no laws governing the practice of management engineering. No license is required. Anyone can hang out a shingle. There is no society in which membership gives prestige or certification of ability. In the absence of any statistics, only a guess can be made about the extent to which management engineering is practiced. In the United States and Canada, about a score of well-known firms plus hundreds of small partnerships and independent individuals do professional management engineering.

Here's how they work. Let us say that a management engineering consultant — or a group of consultants working as a team — is called in to help a company with its problems. They gather facts and opinions from managers, supervisors, and workers. They dig into records and talk with people. They inspect figures, properties, buildings, equipment, and materials. When their information is assembled, they analyze it, and draw conclusions as to the nature of the company's problems and what should be done about them. Finally, they submit written recommendations for action by the management.

Why Call Outsider?

Businessmen often ask, "Why should I pay an outsider to tell me how to run my plant when I know more about it than he could learn in years?" Or they wonder: "Isn't it a sign of weakness to get help from a consultant?" Strange it is, though, that nobody thinks it foolish or weak if a company engages a lawyer, an accountant, or an advertising agency. Each of these has some recognized skill that business managers are not expected to have.

We feel that the consultant has three basic advantages over the client's officers and employees. First, he brings a viewpoint attained by experience with many enterprises. Things are more likely to be seen in proper perspective. Second, his approach to problems is impartial. Personal interest does not color his judgment. Finally, he has time for concentration, free from routine duties. For a client, these advantages have real value. The outside consultant can frequently bring to light situations within an organization that personal interest or company politics hide from higher management. An acceptable visitor may often accomplish by suggestions what executive edicts have failed to do.

But where does the management engineering consultant fit in with the services that you — the engineering consultant — are offering? Certainly, with industry infinitely more technical and complex than it was only a score of years ago, the need for specialists has grown geometrically. And we feel that each consulting engineer, aside from the services he personally offers to a firm, owes his client another service. A specialist should recognize his own limitations — and should know about the services offered by other specialists so that he can recommend them to the client when justified. The "what" of the services offered by other specialists is not the only important factor. Timing — "when" to call in the other specialists — is equally as important. Perhaps this can be best illustrated through examples of recent cooperative consulting assignments.

Other Ills Discovered

A metal manufacturing company was converting some of its present equipment to handle a new type of metal that the company had decided to investigate for expanding its product line. It engaged the services of a consulting mechanical engineer to accomplish the necessary machine modifications. Soon after this specialist began the initial phase of his assignment, he recognized that other plant conditions warranted attention. It was apparent that the flow of material to the machines was erratic. Operators spent a good deal of time waiting for stock to be delivered. The general plant layout did not encourage efficient, economic handling of materials being processed.

We were called in as a result of the consulting mechanical engineer's recommendations to management to correct these conditions. We were also asked to look into other plant operating areas in need of improvement. Certainly, this consultant could have accomplished his assignment regardless of other improvements that were instituted. However, as a consulting engineer he recognized his responsibility to recommend additional expert advice that required another specialist's particular skills. If his own accomplishments were to prove of any real value to the company, corrective action had to be taken in other areas.

Recognize Common Factors

Competent management consultants work in many different industries, in many different localities, and with many different people. This sort of wide experience adds up to detailed knowledge of numerous comparable situations. In the same way that you gain increased knowledge and experience in strictly technical areas of engineering, the competent consulting management engineer also gains experience in recognizing the common factors involved in the effective operation of a business. Production involves materials, tools, labor, and schedules whether the client makes plumbing fixtures or optical instruments. Finance involves

budgets, requirements, timing, and sources of funds in metal-working as well as textile plants.

In addition to providing services to going enterprises, the management consultant is valuable for counsel in programs contemplating purchase, sale, merger, or expanding of business operations.

Collect Special Information

For collection of special information and statistical analysis of such situations, the management engineering consultant is most useful. When the information sought is confidential, engagement of an independent management engineering firm is preferable to that of a large organization. The prowling is less noticeable and therefore less likely to arouse premature publicity.

An important step in deciding whether or not a management consultant should be called upon by engineering consultants for additional specialized services is the consideration of the over-all results that the client hopes to achieve and the manner in which he attempts to accomplish them. Suppose, for example, as a specialist in machine design you are engaged by a client to develop a new piece of equipment that the company desires to introduce on the market. As a result of discussions with management, you learn that the company has not gained any factual information on the potential market for this equipment, on what its advantages or disadvantages are as compared to competitive equipment, and on whether or not potential consumers would find it economical and practical for their operations. Answers to these questions would have to be determined before management could go ahead with its proposed plan to introduce the new equipment to the market.

What can you do as the technical engineering consultant to insure that the knowledge and experience you provide your client in engineering design is not "lost" through inadequate attention by the client to a multitude of other problems? This very situation recently confronted a consulting engineer in machine design. Our firm was called upon to make necessary studies and to translate recommendations into a program of action. The design consultant recognized that his personal assignment would not provide the company with results unless additional professional assistance was made available. The value of his own specialized knowledge was made even more significant as a result of the scientific management engineering approach to the company's over-all objectives.

Act Promptly

We feel that the working relationship between groups of specialists parallels those of medical men. The client organization may need one treatment from one specialist and another treatment from a different specialist. Professional service is localized — much like setting a broken bone or treating specific wound. The danger, of course, is in not acting quickly enough when it looks like additional specialized attention is necessary. The collaborative assistance of consultants, specializing in their own areas, helps to diagnose the problem and then to suggest the necessary action to remedy it.

The qualified consulting management engineer makes his contribution to business health by creating better cost and production control systems, simplifying paperwork, developing incentives, streamlining the organization, valuing jobs, and improving the utilization of facilities. His specialized knowledge and experience bring worthwhile results in combined effort with engineering consultants. Certainly, the facts indicate that these two categories of consultants — engineering and management — are, in reality, destined to be collaborators rather than competitors. ▲▲

---

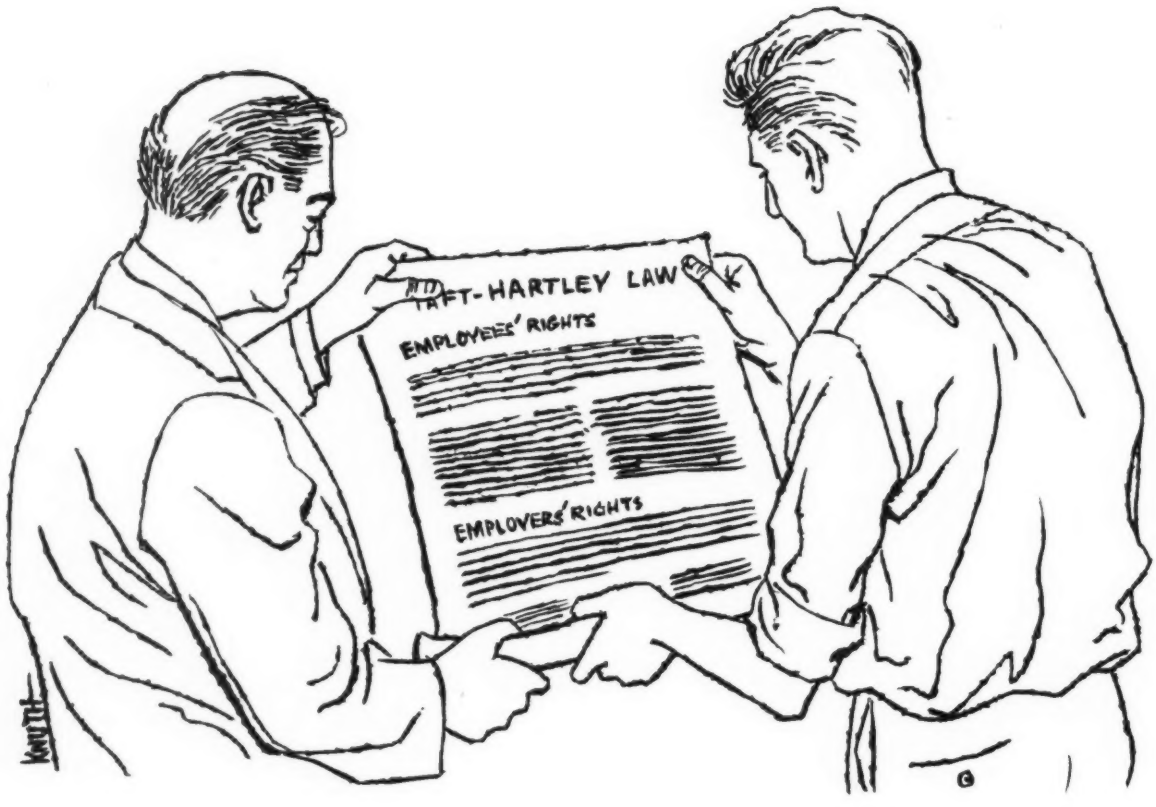
quotes --

One of the aspects of the Technological Revolution is the changed composition of industrial management. Recent surveys indicate that engineers occupy about 20 percent of the top executive posts in leading industrial corporations. Engineers now outnumber both lawyers and bankers as board chairmen and presidents of industrial corporations.

This shift in the makeup of management is, of course, an effect of the changed nature of our industrial economy. A highly technical industry requires men with technical training to understand and guide it. Competitive survival demands sound appreciation of technology at the policy-making level.

When any profession gains dominant voice in industrial management, our economic development reflects that dominance. Thus, when the bankers and financiers were dominant, we experienced great capital expansion and the development of our financial structure. The lawyers developed our corporate organization and lines of liaison with government. Sales people have put the accent upon mass marketing and consumption and have been responsible for our advertising and distribution systems. Technical people in management will inevitably think along technical lines and give impetus to technical development. Thus the Technological Revolution—which has put technologists into top management—will be stoked into greater activity by the management it has created.

Clyde Williams, President
Battelle Institute



CE exclusive

Consulting Engineers and

The Taft-Hartley Act

ROBLEY D. STEVENS, Management Consultant

CONSULTING ENGINEERS must understand the provisions of the Taft-Hartley Act if a labor union attempts to organize their firm's engineering personnel. The Act has definite bearing on what can be said or done.

Section 7 of the Act creates certain employee rights. These rights are: the right to self-organization; the right to form, join, or assist labor organizations; the right to bargain collectively through representatives of their own choosing; the right to engage in other concerted activities for the purpose of collective-bargaining or other mutual aid or protection; the right to refrain from any or all such activities, except to the extent that such right may be affected by an agreement requiring membership in a labor organization as a condition of employment (union shop). These "rights" of employees, who come within the provisions of the Act, must be respected.

The managements of consulting engineering firms have an express interest in another clause of the Taft-Hartley Act. As employers, they are forbidden to engage in what is known as unfair labor practices. This is covered in Section 8 (a), which prohibits interfering with, restraining, or coercing employees in the exercise of the rights guaranteed by Section 7.

A few examples of employer interference that have been forbidden include: threatening employees contemplating joining a union; questioning of employees as to union activities or membership; "spying" on union gatherings; making wage increases deliberately timed to defeat self-organization among the employees; taking an active part in the formation of a labor organization; bringing pressure on workers to join a union; playing favorites with one union as opposed to another; discharging or demoting an employee because of his union membership or activity; refusing to reinstate a laid-off employee because of union sympathy or demanding that he give up union membership in order to be reinstated; and refusing to hire qualified applicants because of previous union membership or activity.

Employees may file charges against an employer

with the National Labor Relations Board. In weighing an employee's charge that he has been discriminated against because of union activity, the NLRB would want to find out about the following points: What reason did the company give for taking the action against the employee? Did the company take the same action against other workers in similar situations? Did the company know that the employee was active in union matters? Was the employee given any warnings before the company acted? What does the employee's record show as to length of employment, efficiency ratings, wage increases, promotions, or words of praise from his superiors? What was the company's attitude toward unions, and what was its attitude particularly toward the employee's union?

Unfair Union Practices

The Taft-Hartley Act, in Section 8, also prohibits unfair practices on the part of unions: to cause or attempt to cause an employer to discriminate against an employee in violation of Subsection (a) (iii) or to discriminate against an employee to whom membership in the union has been denied or terminated on some ground other than his failure to tender the periodic dues and the initiation fees uniformly required as a condition of acquiring or retaining membership; to refuse to bargain collectively with an employer; to engage in, or to induce or encourage the employees of any employer to engage in, a strike or a concerted refusal in the course of their employment; to force or require any employer or self-employed person to join a labor or employer organization; to force or require any employer to recognize or bargain with a particular labor organization as the representative of his employees if another labor organization has been certified as the representative of such employees. In other words, the Taft-Hartley Act differs from the Wagner Act in that it imposes certain duties and controls on labor organizations.

All consulting engineering firms have a special interest in the meaning of "free speech" as revealed in the Taft-Hartley Act. Section 8 (a) provides, "The expressing of any views, argument, or opinion, or the dissemination thereof, whether in written, printed, graphic, or visual form, shall not constitute or be evidence of an unfair labor practice under any of the provisions of this act, if such expression contains no threat of reprisal or force, or promise of benefit."

Professional Employees

Consulting engineers should also remember that Section 9 forbids the inclusion of professional employees in a bargaining unit with nonprofessional employees unless a majority of the professional employees votes for inclusion. Section 2 (12) of the Act provides: "The term 'professional employee' means:

"(a) Any employee engaged in work (i) predominantly intellectual and varied in character as opposed to routine mental, manual, mechanical, or physical work; (ii) involving the consistent exercise of discretion and judgment in its performance; (iii) of such a character that the output produced or the result accomplished cannot be standardized in relation to a given period of time; (iv) requiring knowledge of an advanced type in a field of science or learning customarily acquired by a prolonged course of specialized intellectual instruction and study in an institution of high learning; or

"(b) Any employee, who (i) has completed the courses of specialized intellectual instruction and study described in clause (iv) of paragraph (a); and (ii) is performing related work under the supervision of a professional person to qualify himself to become a professional employee as defined in paragraph (a)."

In making specific rulings, the NLRB looks at the actual work performed by the employee concerned, rather than the employee's formal job classification. For example, the NLRB found in one case that employees engaged in routine electrical and chemical testing were technical rather than professional employees. In another case, a group of chemical testers in the same department was found to be in reality professional on the ground that practically all employees in the group had college degrees in chemistry or chemical engineering, and performed work that involved continual use of scientific knowledge.

Units of Professionals

In addition, the NLRB has construed Section 9 (b) (i) as not precluding the establishment of a single unit composed of both professional and nonprofessional employees, where the group is predominantly professional and includes only a small minority of of nonprofessional employees.

Another significant part is the exclusion of supervisors. The NLRB has continued to exclude from the bargaining unit employees doing confidential work and managerial personnel.

Whenever the NLRB discovers that any person named in a complaint has engaged or is engaging in any unfair labor practice, it is empowered under Section 10 (c) of the Taft-Hartley Act to issue an order requiring such person to "cease and desist from such unfair labor practices." Consulting engineering firms, as well as an employee or a labor organization, may petition the NLRB to investigate or direct an election to establish rights of representation of a bargaining group.

Section 301 (a) permits suits for the violation of contracts between an employer and a labor organization. Such suits may be brought in the Federal District Court that has jurisdiction of the parties.

Not to be overlooked is the fact that the Taft-Hartley Act provides heavy penalties for non-compliance with its provisions — $10,000 fine, imprisonment of one year, or both! ▲▲

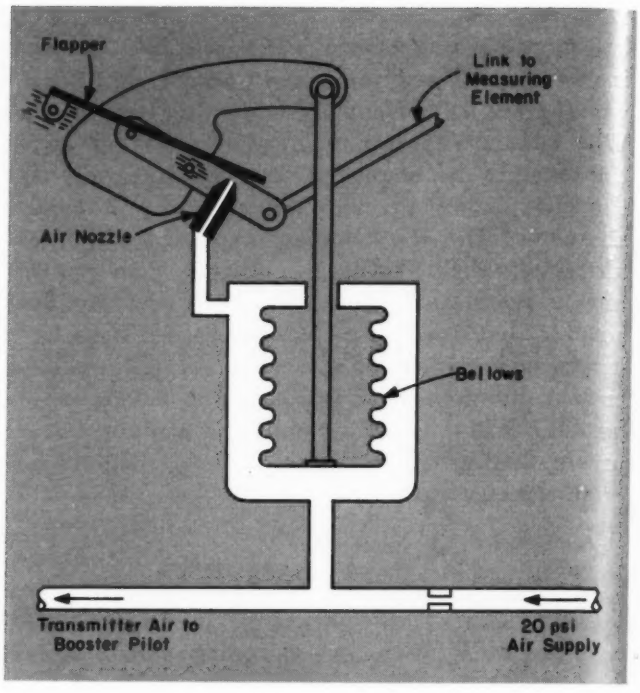


FIG. 1—SIMPLIFIED SCHEMATIC CUTAWAY OF A TYPICAL TRANSMITTER FOR PNEUMATIC CONTROL.

Techniques of Telemetering

S. D. ROSS
Industrial Division (Philadelphia)
Minneapolis-Honeywell Regulator Company

CE exclusive

TELEMETERING is the transmission of measurement from a primary measuring instrument to a secondary recording or indicating instrument some distance from the point of measurement. It may be accomplished by one of several electric or pneumatic means and can include automatic control functions in the transmitter or receiver. Its primary purpose is to bring all instrument indications or records together at one convenient, centralized location (such as a control room) so that the measured and controlled variables can be correlated. Modern instrumentation, and particularly automation, depends largely upon the use of telemetering as a part of the instrument system.

Telemetering systems often include indication of variables at the transmitters for the information of the operator, as well as indication or recording of variables at the distant, centralized panel. Centralized receivers not only oversee widely scattered operations, but also easily and economically gather recorded data for cost accounting purposes. Another important application is the measurement of dangerously high pressures or hazardous fluids. The variables in such environments are converted into electric or pneumatic signals, which are safely wired or piped to remotely located receivers. Telemetering is also being used for remote operation of valves and other devices from a centralized location.

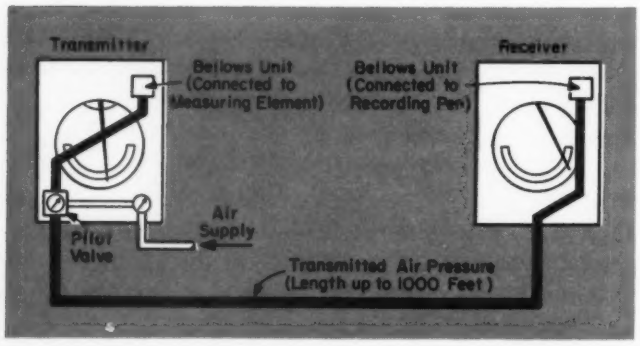


FIG. 2—COMPLETE PNEUMATIC SYSTEM COMPRISES TRANSMITTER, RECEIVER, AND A LINK BETWEEN.

Pneumatic Transmission

Pneumatic transmission of measurements over distances up to about 1000 feet is frequently used, particularly in areas where explosive conditions exist. The variable is translated by a "transmitter" into a proportionate air pressure in the range of 0 to 20 psig; this pressure is piped through small-diameter tubing to a "receiver," which is simply a pressure gage calibrated in terms of the variable actually being measured.

Limitations exist on the distance over which pneumatic transmission is feasible because of the time lag caused by the flow resistance and volume in the connecting tubing. The time lag is relatively small up to about 500 feet. Distances up to 2000 feet can be tolerated in pneumatic transmission if care is taken to minimize the time lag by the use of larger diameter tubing. (Generally, the standard tubing is ⅜- or ¼-inch diameter (O.D.) copper tubing.) Booster pilots installed along the transmission line also help reduce lag.

Pneumatic transmission can use natural gas or other gases as the operating medium. This is advantageous where no source of electric power is

available to operate the telemetering system. Another important reason for the use of the pneumatic system is its versatility in tying in with pneumatic control units, such as pneumatic-balance ("stack-type") controllers or pneumatic set-point positioning devices for cascade and ratio control. In general, pneumatic systems still predominate in the instrumentation of process plants and are frequently used in central stations.

Basic Principles

As shown in Fig. 1, a typical pneumatic transmitter consists of a flapper and an air nozzle similar to that used in pneumatic control. Changes in the variable are translated into movement of an arm. The arm is linked to the flapper which covers or uncovers the air nozzle, thereby changing the pressure around the bellows by allowing more or less air to escape.

At the same time, this change in pressure causes the bellows to move, which changes the position of the flapper pivot in such a way that only a small differential change in position of the flapper occurs for a given change of the variable. With such a system the flapper can be positioned within extremely fine limits (fractions of a thousandth of an inch).

As shown in Fig. 2, the transmitter requires a supply of clean compressed air of at least 20 psig pressure. A single tubing line is run to the receiver. In the receiver, the pressure bellows is practically identical in design to the transmitter's bellows, being matched in mechanical characteristics to provide accuracy of pressure transmission generally better than $\pm$ 1 percent of scale.

Pneumatic-Balance Principle

A number of present-day instrument designs employ what is termed the "pneumatic-balance" principle as a means of measurement. This method involves the balancing of a force due to the measured variable against a regulated pneumatic force, much the same as a weighing scale balances an unknown weight against calibrated weights. Because such an instrument creates a pneumatic pressure as a measure of the variable, it is inherently a pneumatic transmitter, with generally excellent response to changes in the measured variable and with high accuracy.

Shown schematically in Fig. 3 is a cross-section of a typical pneumatic-balance unit, designed to measure differential pressure. It is primarily used as a manometer for the measurement of flow in a pipeline. As illustrated, the basic principle of this "dry flow meter" is that the differential pressure across a diaphragm in the pipeline is converted to a force acting on one end of a lever system. A flapper and nozzle arrangement creates an opposing force due to air pressure just sufficient to balance the force due to the differential pressure. The output air pressure, normally amplified by a pilot relay, is then proportional to the differential pressure and can be transmitted to a pressure receiver calibrated to read

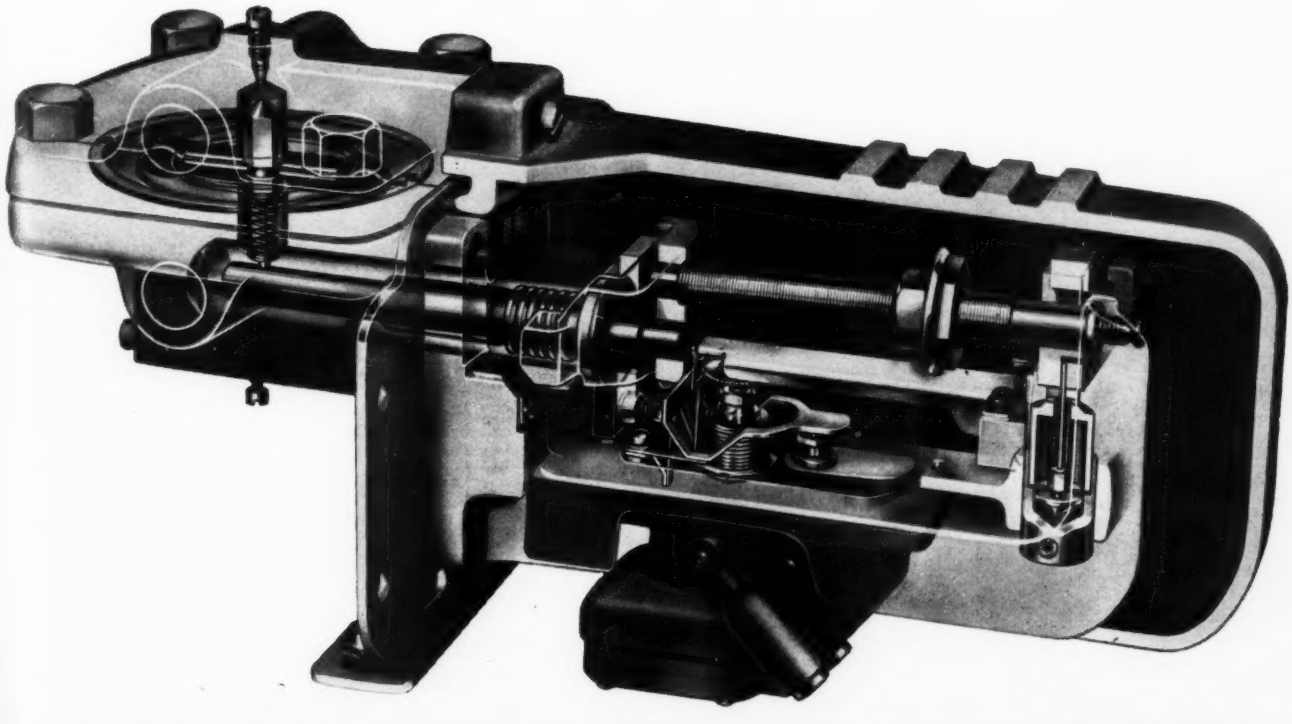


FIG. 3—IN DIFFERENTIAL CONVERTER, PRESSURES REPRESENTING FLOW ACT THROUGH DIAPHRAGM (LEFT) ON BEAM SYSTEM. THIS IS BALANCED BY AIR PRESSURE ON OTHER END OF BEAM. THIS PRESSURE INDICATES FLOW.

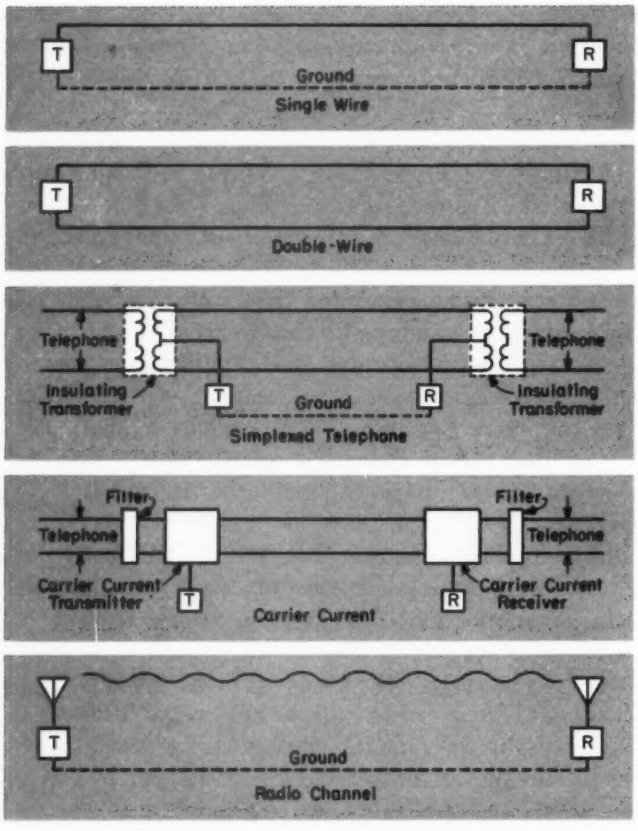


FIG. 4—THERE ARE SEVERAL METHODS OF CONNECTING TRANSMITTERS (T) AND RECEIVERS (R).

directly in terms of flow rate. The pressure receiver can be the same as that just described for the "matched bellows" system. But more often, today, it is a miniature recorder as used on graphic panels that are becoming so popular.

Electric Systems

Electric telemetering systems can be classified into five types, according to the signal transmitted: voltage, current, position (or ratio), impulse, and frequency. In general they have the following characteristics:

¶ Electric power is generally available.

¶ Transmission lines are relatively cheap and inexpensive. Lines already existing for other purposes sometimes can be used.

¶ Measurements can be transmitted over almost unlimited distances.

¶ Time lags in transmission are negligible.

¶ Explosion-proofing may be required and adds appreciably to the installed cost.

¶ Most common modes of automatic control are available, but throttling-type motors are considerably more expensive than their pneumatic equals.

Voltage Systems

Although not generally classified as telemeters, many common industrial instruments convert their measured variables into an a-c or d-c voltage. Thermocouple or radiation pyrometers, tachometers, differential transformers, and many other electrical measuring instruments fall into this class. Transmission distances from element to instrument normally are 1000 feet or less. Self-balancing potentiometers are the usual receivers — providing indication, recording, and automatic control if desired. However, thermal converters (which convert a-c power into a d-c millivoltage) are extensively used in the power industry. Load measurements can be transmitted from several stations to a central office over distances as long as 50 miles. Good quality cable circuits are required for such distances.

Voltage telemetering systems, in general, are affected by line resistance, leakage, and noise. They usually require a more expensive receiving instrument and are not adaptable to the use of several receivers at the same time. The use of one wire and ground is not normally permissible.

Current Systems

Variation of current by altering a resistance in the line has been employed in a number of telemetering systems. Most of these include feedback to balance against the input quantity, and some type of detector-amplifier combination to detect any unbalance and correct for it. A few milliamperes of d-c are normally used.

Current systems generally develop higher voltages than voltage systems, and thus can be made more immune to the effects of line resistance or thermal and inductive voltages in the connecting lines. Transmitters are relatively expensive because of the feedback required, but inexpensive milliammeters can be used as receivers without calibration for line resistance. Speed of response is high with many of the types available.

Position Systems

The many different-appearing types of position (or ratio) telemetering have the common characteristic of varying the relative magnitude of two or more quantities in proportion to the measured variable. The quantities being varied may be resistances, inductances, a-c voltages, and so on. Resistance slidewires, inductance bridges, and Selsyn-type motors are examples.

Most position (or ratio) systems are designed for distances varying from a few hundred feet to a few miles. Some require more than two connecting wires. The transmitters are usually inexpensive and require but low forces from the primary element.

Impulse Systems

Impulse telemetering systems operate by the variation of a series of electrical impulses in some manner in accordance with the value of the measured variable. Although impulse-amplitude and impulse-spacing systems have been used in radiosonde and

military applications, impulse-duration and impulse-rate methods are more common in industrial use. Impulse-rate systems cost more, but have faster response and are designed primarily for long distances over carrier channels. Impulse rates of 20 to 100 per second make this system very responsive.

Frequency Systems

Frequency telemetering systems operate by varying the frequency of an a-c signal in accordance with the measured variable. As such, they are similar to impulse-rate systems. Most commercial equipment can be readily adapted to either. Frequency telemetering is primarily designed for high-speed, long-distance transmission of data over carrier channels.

Impulse-Duration Telemetering

Impulse-duration telemetering is often employed for long-distance telemetering — such as on natural gas, crude oil, or petroleum pipelines. The system can operate over two wires, a telephone circuit, or over a radio beam (Fig. 4). Completely unattended stations have been made entirely automatic. Pressures and flow rates are transmitted to central supervisory or dispatch stations, where an operator can position valves, open or close line valves, fill holders, or check optional pressures or flows not normally telemetered — all such functions being accomplished by remote control.

In such systems, the transmitted signal has a duration that is proportional to the measured variable. In essence, its operation may be likened to that of a telegraph system. The transmitter would be analogous to the telegraph key and the remotely located receiver would be analogous to the telegraph buzzer. In this comparison, a value of pressure, for example, would be related to the length of time the key is depressed — a signal of 10 seconds representing 10 psi, 20 seconds representing 20 psi, and so on.

Another variation of the impulse-duration system uses two synchronized cams, one in the transmitter and one in the receiver. Each cam is driven by a clock motor. Each cam closes a contact for a period proportional to the position of a variable pointer or recording pen on the instrument. If the duration of the contact is not the same in the receiver as in the transmitter, a reversible motor in the receiver is energized to reposition the recording pen so that the receiver's indication becomes the same as the transmitter's indication.

Consecutive Transmission

Where conditions are such that continuous readings of several telemetered variables are not required, a multiple-point strip chart recorder can be used as a receiver, connected consecutively by means of a timing switch to as many as 16 transmitters. This arrangement cuts costs where leased-wire facilities are used for transmission. Similarly, if separate continuous circular chart recording receivers are employed, a pair of synchronized timing switches at transmitter and receiver locations have been used to time consecutive data transmissions.

In addition to the interconnecting means between transmitter and receiver shown in Fig. 4, considerable work has been done recently with microwave transmission in both the 960- and 2000-megacycle band. At these ultra-high frequencies, antennas with parabolic reflectors are used. Transmission over 40 miles of level terrain has been accomplished without repeater or relay stations. If hills do intervene, relay stations are required. Microwave equipment suitable for use with impulse-duration telemetering systems is now available.

Frequency Carrier Systems

Shown schematically in Fig. 5 are the essential components of one frequency telemetering system used for long-distance transmission of any variable that can be converted to a proportional d-c equivalent. The system is particularly adaptable to the requirements of central stations. Carrier equipment, microwave equipment, or a telephone-pair connecting circuit (for relatively short distances) can be employed for such transmission.

Most electrical measurements are made with a thermal converter. Transducers, tachometers, or slidewires are employed to translate other variables into a d-c millivolt input. Conversion from millivolts to a frequency signal is made by an electronic transmitter that has an output frequency, in the

—Continued on page 78

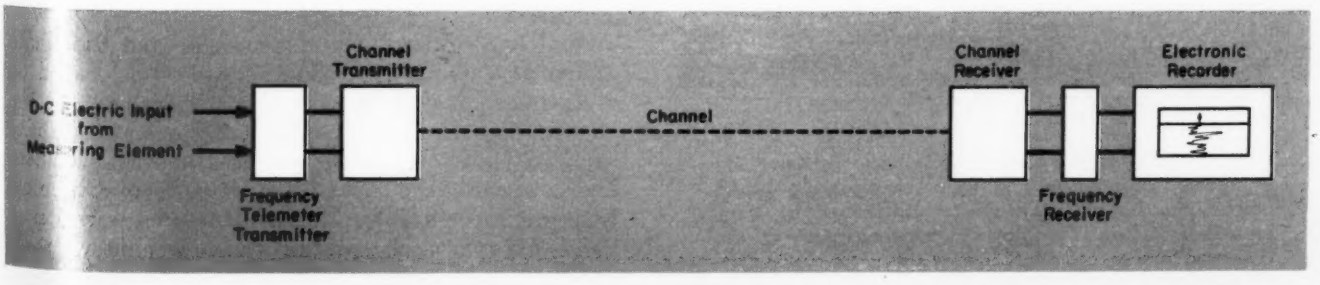
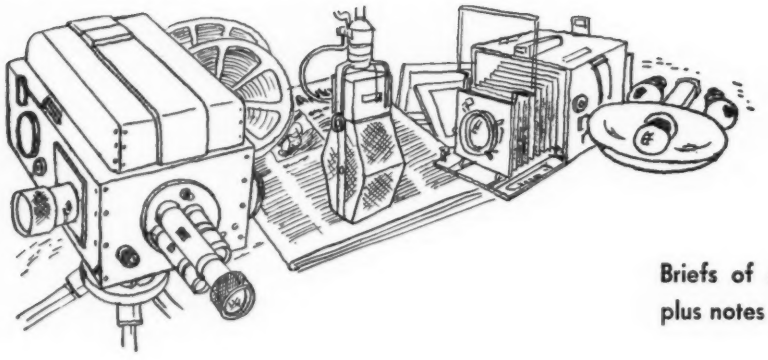


FIG. 5—THIS BLOCK DIAGRAM SHOWS RELATION OF COMPONENTS IN FREQUENCY-TYPE TELEMETERING SYSTEM.



NEWS

Briefs of current interest to the consulting profession plus notes on new equipment in the field of engineering

The Question Is, Do Engineers Consider Engineering a Profession?

At the first General Assembly of Engineers Joint Council, held in New York City Jan. 21, Dr. G. Brooks Earnest, chairman of the panel "Employment Conditions and Unionization—Their Effect on the Engineer," reported on the questionnaire submitted to members of ASCE, ASME, and AIEE on unionization. Of the 112,225 questionnaires mailed, 64,206 or 57 percent were completed and returned.

The results lined up this way:

¶ Presently members of established collective bargaining groups—2348, or 3.7 percent;

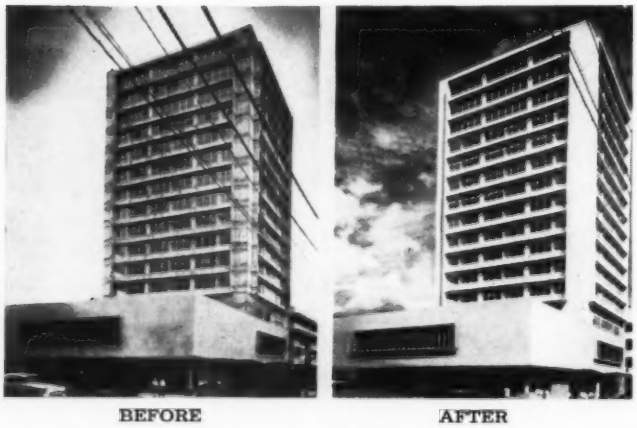
¶ Not opposed to collective bargaining—17,318, or 27 percent;

¶ Believed collective bargaining would be advantageous—12,833, or 20 percent;

¶ Opposed collective bargaining for professional engineers—45,992, or 72 percent;

¶ Felt collective bargaining is incompatible with professional status—42,314, or 66 percent.

Dr. Earnest pointed out "The results of the questionnaire from these three societies present a challenge to the engineering profession. We do not know the thinking of the remaining 43 percent of the 112,225 members polled who did not respond. But, assuming it might approximate the thinking of the 57 percent responding, there then would be 31,500 members who are not opposed to collective bargaining for professional engineers. We are charged with the responsibility of first converting 31,500 of our own members to the professional status category."



BEFORE AFTER

The Carlton Hotel, Tyler, Texas, was designed by architects, Design, Inc., to utilize sprayed-on liquid plastic Plasticspray as a veneer instead of brick or aluminum facing. The plastic, applied directly to the concrete, eliminated need for flashing, coping, facia, and caulking and will last the life of the building. Liquid Plastics Corp., Long Island City, are distributors.

Committee Advises Engineers To Accept Pittsburgh Offer

The Committee of Five (past) Presidents of the engineering societies has submitted its recommendation "that the headquarters of the engineering societies be located on one of the sites in the city of Pittsburgh." The committee also recommended that the four Founder Societies—Civil, Mechanical, Mining & Metallurgical, and Electrical—liquidate the United Engineering Trustees and join with the American Institute of Chemical Engineers to form a new corporation to build, operate, and maintain the new engineering center.

Text of the report reads as follows:

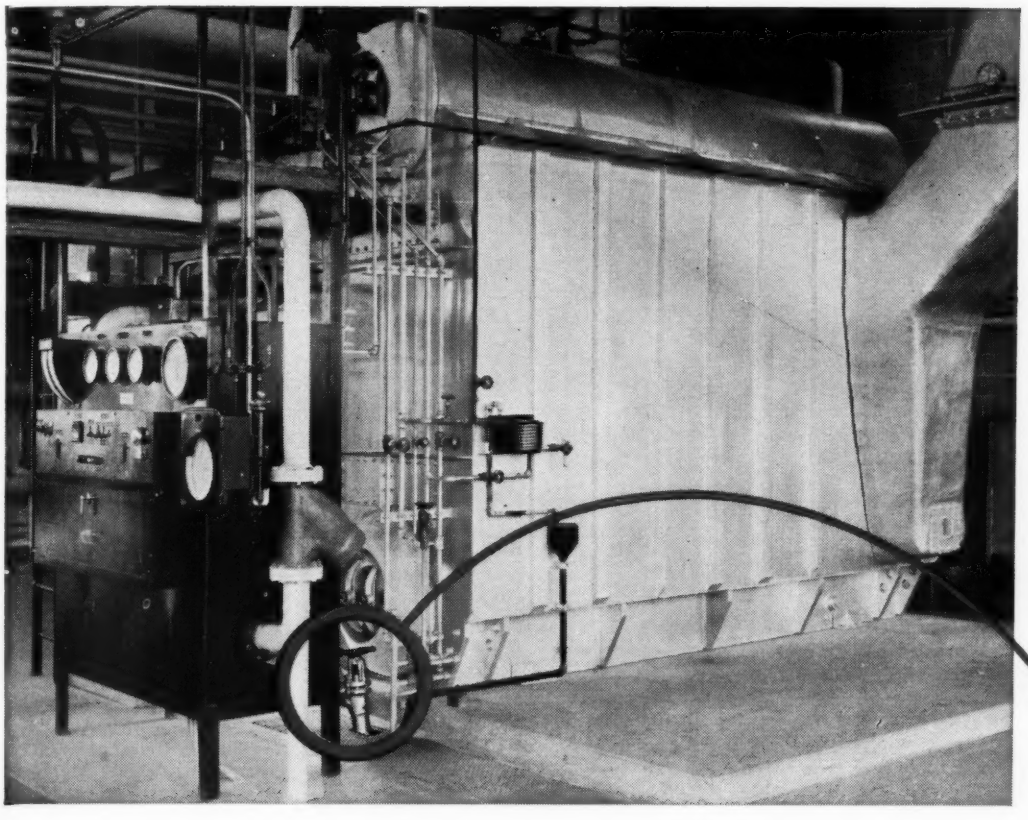
"After extended study and careful consideration of all the data made available to us as of January 31, 1955 regarding proposed location in New York, Philadelphia, Pittsburgh, and Chicago, we offer the following:

"In considering the New York proposed Columbus Circle site, the Committee felt that this was not an acceptable location. We, therefore, gave careful consideration to a preferred site generally defined as being in the Grand Central area. In like manner we considered the Illinois Institute of Technology site as not being acceptable and gave careful consideration to a preferred site in the Chicago Loop.

"Based on the lowest capital cost and lowest annual expenditure, we recommend that the headquarters of the engineering societies be located on one of the sites in the city of Pittsburgh.

"We further recommend that the four founder societies liquidate the United Engineering Trustees and join with the American Institute of Chemical Engineers in the formation of a new corporation to build, operate, and maintain the new center.

"We consider that this concludes the assignment given us and we, therefore, consider that the Com-



COMBUSTION ENGINEERING ADOPTS YARWAY SEATLESS BLOW-OFF VALVES FOR PACKAGE BOILERS

Combustion Engineering, Inc. on this package boiler installation at the Orangeburg Pipe Plant in California, again includes Yarway Seatless Blow-Off Valves as part of the "package."

It's a popular idea—and growing fast. All *good* package-type boiler installations are *better* when equipped with Yarway Seatless Blow-Off Valves.

More and more boilermakers are standardizing on Yarways, and more and more boiler users are expecting the advantages of Yarway Blow-Off Valves on their package units.

Get the full story on why more than 15,000 boiler plants use Yarway Blow-Off Valves, some for 30 to 40 years.

YARNALL-WARING COMPANY
106 Mermaid Avenue, Philadelphia 18, Pa.
BRANCH OFFICES IN PRINCIPAL CITIES

Yarway Type "B" Seatless Tandem Blow-Off Valve. Note balanced sliding plunger design with no seat to score, wear, clog or leak. Pressures to 400 psi.

YARWAY BLOW-OFF VALVES

Pittsburgh Offer Recommended

—Starts on page 64

mittee of Five Presidents is hereby discharged."

The report was signed by Elgin B. Robertson, American Institute of Electrical Engineers, chairman; Daniel V. Terrell, American Society of Civil Engineers; Lewis K. Sillcox, American Society of Mechanical Engineers; Leo F. Reinartz, American Institute of Mining & Metallurgical Engineers; and Chalmer G. Kirkbride, American Institute of Chemical Engineers.

Vibration Isolators Replace Concrete Foundations

Tests conducted in the plant of Pneumatic Drop-Hammer Co. by the Korfund Co., Inc. indicate that it is possible to install hammers without special concrete foundations or timber pads.

In the tests, a standard model hammer, weighing 21,000 lb, including a 900 lb falling ram weight, was mounted—without bolting—directly on four Korfund Steel-Spring Vibro-Isolators, one under each corner of the anvil. The isolators contain internal leveling screws which eliminate shims and simplify leveling. They were not bolted to the machine or to the floor and no special concrete foundations or timber pads, commonly installed under this model hammer, were used. An oscillograph was set up with the acceleration pick-up placed on the floor immediately adjacent to the isolators. For the tests, readings were taken to determine amplitude of the floor movements due to the impact.

During operation of the hammer in a production type run, speed of production and quality of work were equal to that produced by a conventionally mounted hammer. With the pick-up right beside the hammer, operation produced no more recorded movement on the oscillograph than slapping the floor adjacent to the pick-up with a bare hand. With the hammer operating and the pick-up set on the floor approximately 12 ft from the hammer, the oscillograph did not record any floor vibration.

Cost of the approximately 25,000 lb of reinforced concrete usually needed for a conventional foundation is about $300 exclusive of labor and excavation costs. This saving alone more than pays for the steelspring isolators used in the test.

States Push for Better Water Pollution Control

New and stronger laws to curb water pollution from industrial wastes and municipal sewage are currently being sought in a number of states including a Missouri legislative proposal for the creation of a new state water pollution control board.

The Missouri bill, sponsored by Rep. Robert C. Smith, Jr., of Columbia, calls for an immediate

States Push Pollution Control

—Starts on page 66

study of the situation on the basis of which standards of allowable pollution would be established. Permits for new industrial waste and municipal sewage disposal units would be issued, subject to revocation by the board if standards were not met.

The proposed board would operate under the state Department of Public Health and Welfare and would be composed of the heads of health and welfare, conservation commission, resources and development, business and administration and agriculture, and the state geologists. In addition, the governor would name four members, for four-year terms each, representing agriculture, industry, municipalities, and recreation.

That New Jersey's anti-pollution laws have teeth in them was demonstrated when Superior Court Judge Vincent S. Haneman recently imposed fines totaling $6500 against the borough of West Wildwood and three of its councilmen for ignoring a court order to provide adequate sewage disposal facilities for that municipality.

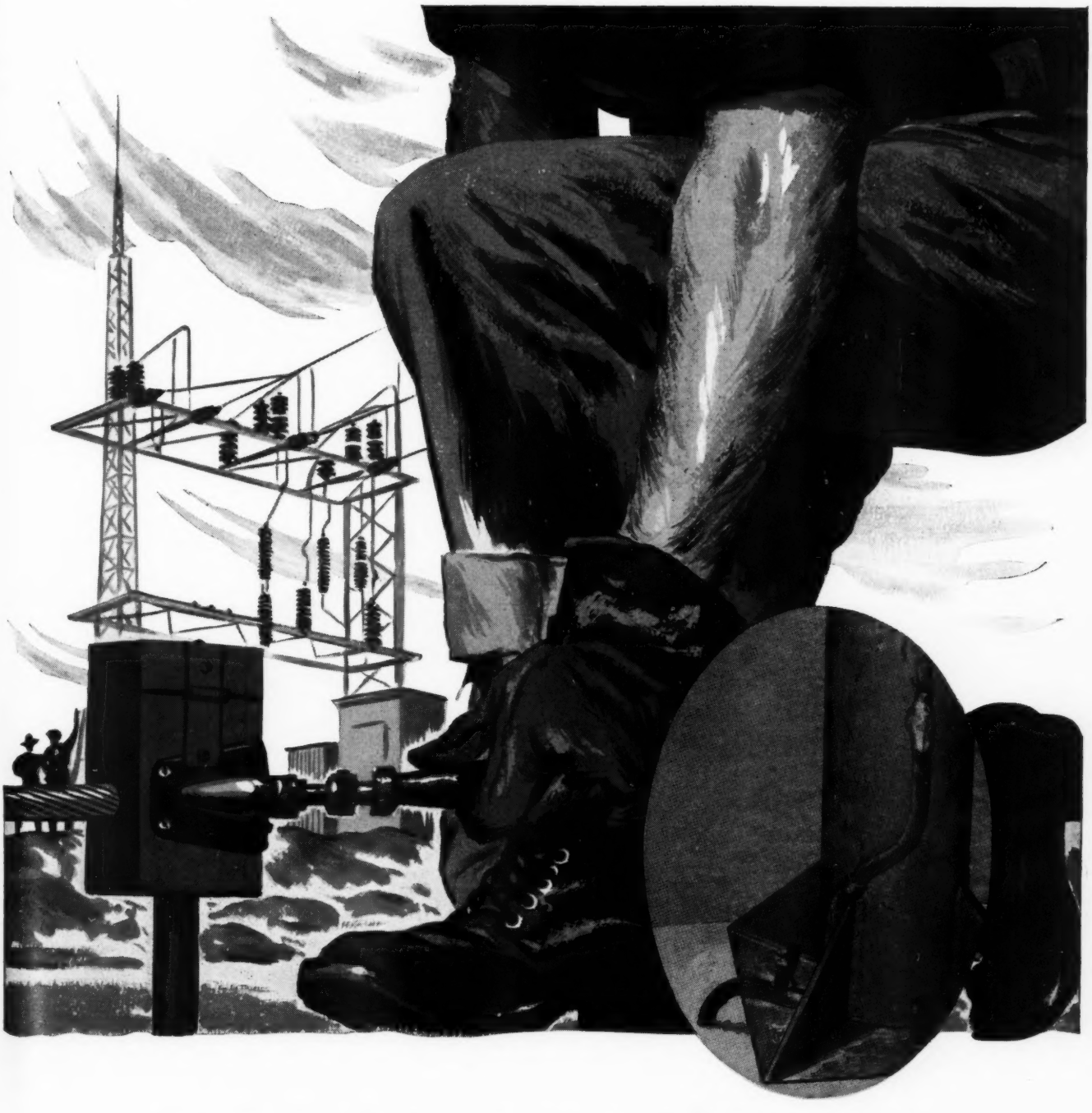
City officials in Ashland, Ky. recently conferred with consulting engineers on the proposed construction of a sewage disposal plant to cost some $2 million. The plant would be erected to comply with the Ohio River stream pollution control pact. The city may need two sewage plants, although preliminary plans call for the construction of one plant somewhere in the west end of the city and the use of interceptors and pumps to feed sewage to it.

The sixth annual report of the Ohio River Valley Water Sanitation Commission, presented to the governors of the eight states which are joined in the Ohio River stream pollution control pact, showed that 45 percent of the population in the area covered is now served by sewage treatment. An additional nine percent will be served by treatment plants under construction, and 26 percent by plants plans for which are approved for construction.

One of the major accomplishments of the Commission during the past year was the completion of engineering studies, public hearings, and the promulgation of requirements for sewage discharges in the entire 981 miles of the Ohio River. The regulations are set forth in seven standards, each applying to a different section of the river.

An important adjunct to the development of control measures is the service being rendered by some 150 representatives of major industries in the valley. They are grouped into seven industry-action committees and they are counselling with the Commission on abatement of industrial waste pollution.

A special committee of aquatic-life experts is also completing recommendations to guide the Commission in safeguarding waters and is preparing a manual outlining data to be collected for prompt evaluation of the causes of fish kills. ▲▲



Permanently grounded for complete protection

Just as important as the equipment that goes into a new utility or sub station is the protection of that equipment. Grounding of every unit is an important part of that protection. For the best GROUNDING system possible, specify CADWELD electrical connections. They are permanent, cannot loosen or corrode and have a greater current carrying capacity than the conductor itself.

CADWELD®

Erico Products, Inc.

2070 E. 61st Place • Cleveland 3, Ohio

IN CANADA: ERICO INCORPORATED, 3571 Dundas St., West, Toronto 9, Ontario

A Matter of Ethics

CONSULTING ENGINEER *will pay $25.00 for each published example of problems of professional ethics sent in by readers.*

Another $10.00 will be paid for the best discussion of the problem published below.

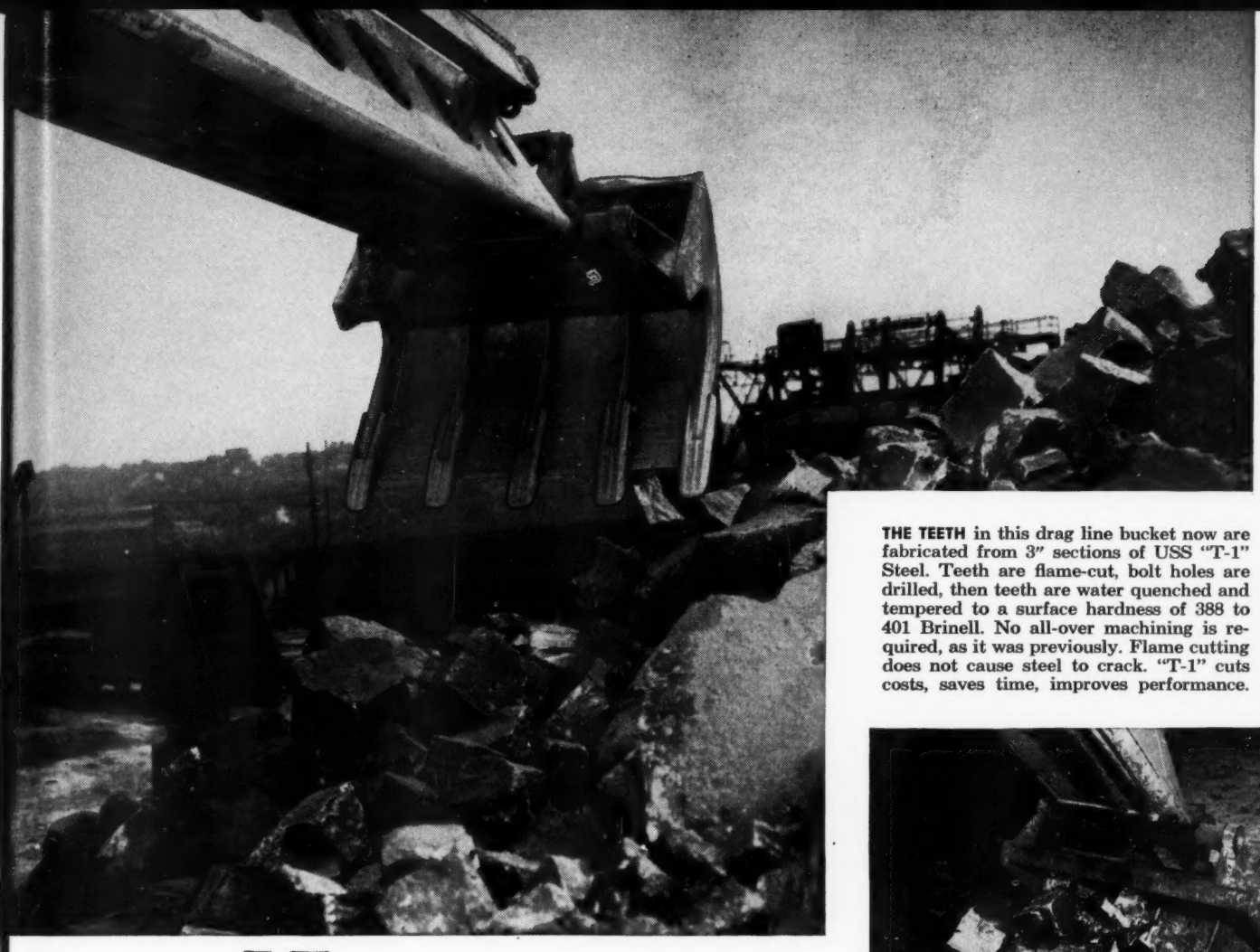
Address letters to: The Editors CONSULTING ENGINEERS, *St. Joseph, Mich.*

A GROUP of consultants with excellent political connections were retained for the design of a water supply — flood control dam as part of a combined state-municipal conservation program. In the course of this work they requested, and were supplied with, technical information on gate hoisting and auxiliary equipment. The regional sales representative for a leading manufacturer of such equipment was especially helpful to them.

The process was perhaps subconscious, but to avoid the delay and effort required for a full survey of competitive equipment (plus the abstraction process needed to produce general descriptions that could be filled by all manufacturers) word-pictures of the cooperating company's products found their way into the official published specifications.

When bids were called for, the manufacturer's agent principally concerned (an old and knowing participant in these matters) realized that his firm could give considerable inside help in the preparation of bids. Choosing the contractor who appeared to be in the best position to get political preference, and who happened to be a long-term user of the company's products, the sales engineer offered his assistance in writing the relevant sections of the bid. In return he only asked for signed orders in advance of the bidding, to be torn up if the bid were not successful.

Recognizing the peculiar coincidence of specifications and bid sections, the contractor cheerfully if not joyfully accepted the representative's proffered assistance. The manufacturer's representative then prepared the bids and filled



THE TEETH in this drag line bucket now are fabricated from 3" sections of USS "T-1" Steel. Teeth are flame-cut, bolt holes are drilled, then teeth are water quenched and tempered to a surface hardness of 388 to 401 Brinell. No all-over machining is required, as it was previously. Flame cutting does not cause steel to crack. "T-1" cuts costs, saves time, improves performance.

How USS "T-1" Steel in Drag Line Bucket Teeth increased service life ten times

This hefty drag line is used to break and load ferromanganese which is made by the Blast Furnace Department of U.S. Steel's Duquesne Works. Ferromanganese is extremely hard and dense, so the bucket teeth must have exceptional resistance to impact abuse and abrasion.

When we bought this machine, the manufacturer used the best steel then available for the job. But still the teeth broke easily — and lasted for only 4 to 8 hours of operation. Replacement down time was frequent and expensive.

Just as an experiment, we tried our new "T-1" Steel in this rugged application. It worked beautifully. Instead of 8 hours, we are getting *80 hours* of service from each set of teeth — ten times more. Down time and replacement costs are about *a tenth* of what they used to be. Naturally we'll continue to use "T-1" Steel in this job, in the entire bucket as well as the teeth.

USS "T-1" Steel can cut costs for you in a wide variety of applications. Write for detailed facts and figures.

USE "T-1" AT HIGH TEMPERATURES. New USS "T-1" Steel has good creep rupture strength up to 900° F. It is being used in heavy-duty parts that operate at high temperatures.

USE "T-1" AT LOW TEMPERATURES. This same steel is amazingly tough at sub-zero temperatures. In pressure vessels, it has survived impacts of 2,000,000 ft. lbs. at 38 degrees below zero F. In addition, it has good resistance to impact abrasion.

USE "T-1" TO CUT FABRICATING COSTS. You have a yield strength of 90,000 psi. in "T-1" yet you can weld or flame cut this steel without pre- or post-heating. Your welds will develop the full 90,000 psi. And you can fabricate parts either in the shop or the field—wherever it is more convenient and less costly. With "T-1" Steel you can save money or improve design—sometimes both—in bridges, pressure vessels, heavy-duty trucks, excavating machines, mine cars, high speed rotating machines, steel mill equipment, and stamping and forging presses.

UNITED STATES STEEL CORPORATION, PITTSBURGH • COLUMBIA-GENEVA STEEL DIVISION, SAN FRANCISCO
TENNESSEE COAL & IRON DIVISION, FAIRFIELD, ALA. • UNITED STATES STEEL SUPPLY DIVISION, WAREHOUSE DISTRIBUTORS, COAST-TO-COAST
UNITED STATES STEEL EXPORT COMPANY, NEW YORK

USS "T-1" CONSTRUCTIONAL ALLOY STEEL

USS

5-20

UNITED STATES STEEL

A Matter of Ethics

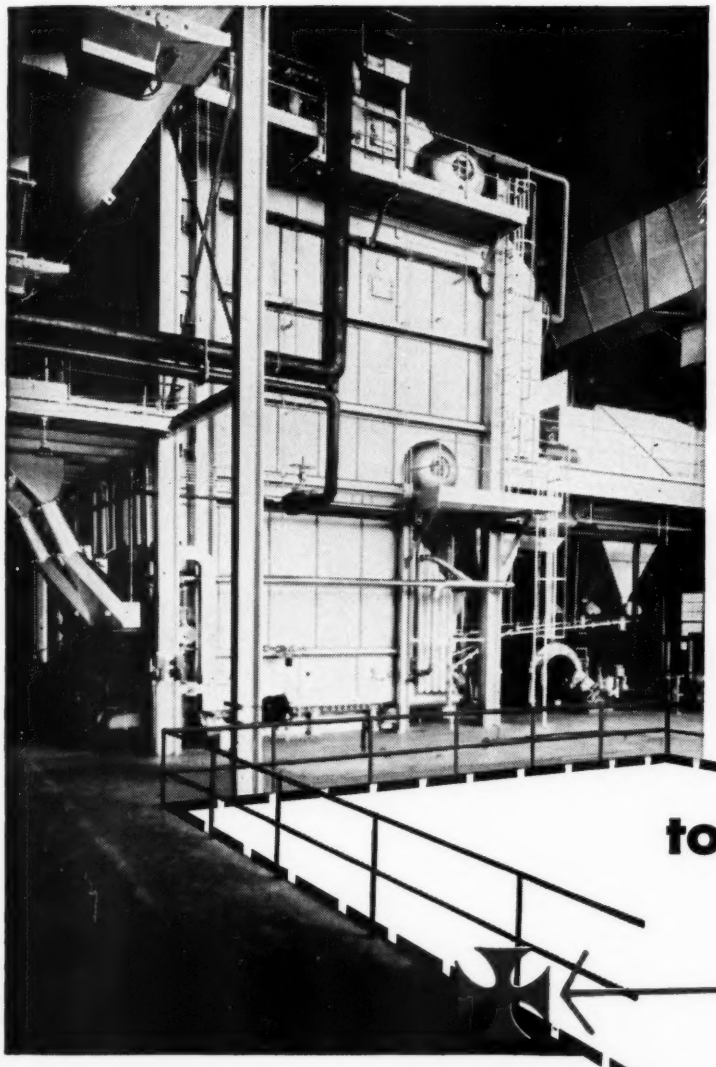
—Starts on page 70

out order forms for all the equipment specified. (These were to be signed and returned to him if the contractor received the bid.)

A final bid utilizing the brand names from the manufacturer's catalog was then submitted, was accepted, and the purchase orders were executed. Other bidders were out in the cold, but the agent had a neat commission of over $100,000, the contractor had a sure job with a profit of a million or more dollars, and the design engineers had their project well on the way to completion. Under these circumstances, everybody was happy except the other bidders, and perhaps the public, had the public known.

Were the consultants unethical in their handling of this product?

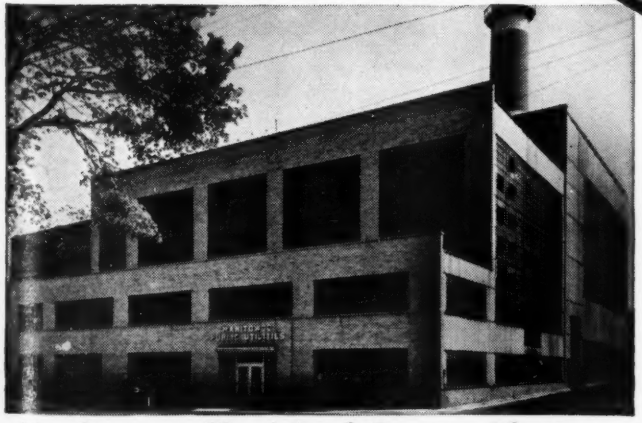
What are minimum requirements for drawing up competitive specifications? ▲▲



another Detroit RotoGrate Stoker for Manitowoc

Wisconsin

to be installed here



Manitowoc Municipal Power Plant
R. E. Cannard, General Manager and Chief Engineer

In 1950 the Public Utilities Commission of the City of Manitowoc installed their first Detroit RotoGrate Stoker with a 175,000 pound per hour Wickes steam generator.

This installation has been so successful that the Utilities Commission has ordered a second Detroit RotoGrate Stoker to fire another Wickes steam generator of 200,000 pound per hour capacity to be installed adjacent to the first unit. Either Ohio or Indiana coal is used.

Detroit RotoGrate Stoker is an advanced design of spreader stoker with grates that move slowly forward continuously discharging ash at the front. Burns a wide range of Bituminous coals or Lignite without special preparation, also hogged wood or bark and other refuse fuels.

Efficiency and burning rates are high with either steady or rapidly fluctuating loads. Parasite power is low. Combustible content of ash is usually less than 2%.

Get complete data on Detroit RotoGrate Stokers. Recommendations and Bulletins supplied without obligation.

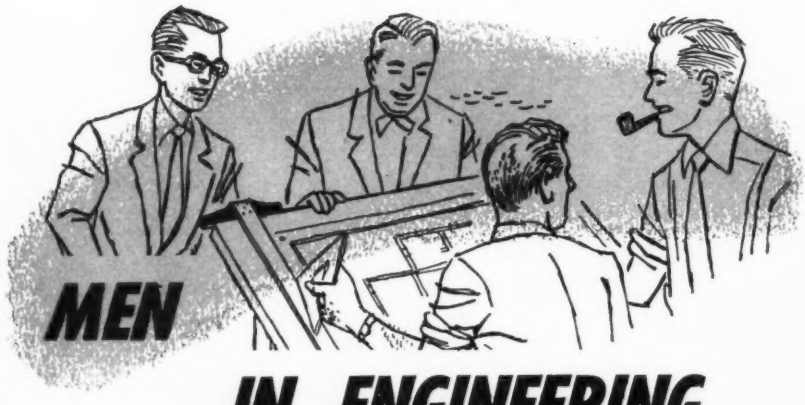
6852

DETROIT SINCE 1898 STOKERS

DETROIT STOKER COMPANY

General Motors Building—Detroit 2, Michigan

District Offices in Principal Cities • Works at Monroe, Michigan



IN ENGINEERING

★ New officers of the American Institute of Consulting Engineers are: president, Francis S. Friel, Albright & Friel, Inc.; vice presidents, Clinton D. Hanover, Jr., Hardesty & Hanover, and Carlton S. Proctor, Moran, Proctor, Mueser & Rutledge; secretary, T. T. McCrosky, consulting engineer; treasurer, George C. Diehl.

★ Frank E. Cummings has been made a partner in the firm of Drake, Startzman, Sheahan & Barclay.

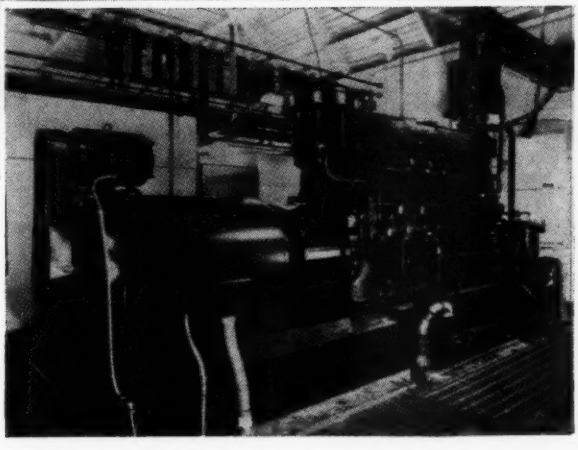
★ The American Society of Mechanical Engineers has elevated three men to the rank of Fellow: Montrose K. Drewry, chief engineer of power plants, Wisconsin Electric Power Co.; Harry R. Kessler, manager of the New York office of Republic Flow Meter Co.; and James M. Landis, chief power engineer, Bechtel Corp.

★ John W. Tyler is appointed staff engineer, American Engineering Co.

★ The Peter F. Loftus Corp. announces election of Carroll T. Sinclair as vice president. He will direct design and consulting engineering activities of the utility division.

★ T. C. Williams, executive vice president, Stone & Webster Engineering Corp., is elected president of

Power failure no longer threatens Attleboro's water supply



This Model 40-S-8 Superior Diesel is rated at 435 hp at 900 rpm. It protects Attleboro's 24,000 citizens by being ready to supply their water needs, including fire protection, for long periods of time.

Not long ago, frequent power failures stopped vital city water pumping in Attleboro, Mass. Experiencing five or six such failures per year, city officials acted to assure the community a continuous water supply. They installed a generator set powered by a heavy-duty Superior Diesel model 40-S-8 to provide power during such failures.

As Mr. Russel F. Tennant, Supt. of Public Works, stated...they needed an engine that would "stay in there and deliver!" It didn't take long to realize the value of their new Superior Diesel. When hurricane "Carol" hit Attleboro last year, causing a million dollars worth of damage, the central station power was lost almost immediately. Superior power went right into action.

For two full days this Superior carried the entire load for pumping and building lighting. Result: "All operating routine was carried through splendidly." In referring to this emergency situation Mr. Tennant said, ". . . we certainly are proud and of course relieved, to own this engine and generator of proven worth."

Whatever your power generation requirements, be sure you have all the facts on National Supply's complete line (4 to 1765 hp) of Superior, Atlas and Lister Diesels. Write or call Engine Division offices in Springfield, Ohio, or contact the nearest sales and service point listed below for complete information.

DIESEL DUAL FUEL GAS

THE NATIONAL SUPPLY COMPANY

ATLAS Imperial DIESEL ENGINES

Superior ENGINES

DISTRIBUTOR OF Lister DIESELS IN U.S.A.

THE NATIONAL SUPPLY COMPANY

ENGINE DIVISION PLANT AND GENERAL OFFICES: SPRINGFIELD, OHIO

SALES AND SERVICE POINTS: Gloucester, Massachusetts • Houston, Texas • Fort Worth, Texas • San Diego, California Oakland, California • Terminal Island, California • Ketchikan, Alaska • Washington, D.C. • Chicago, Illinois • Portland, Oregon • Astoria, Oregon • Casper, Wyoming • St. Louis, Missouri • Halifax, Nova Scotia • Vancouver, B. C. • Park Rapids, Minnesota • New York, New York • Seattle, Washington • New Orleans, Louisiana • Pittsburgh, Pennsylvania

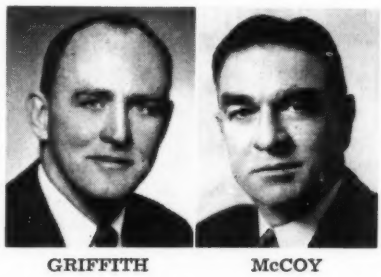
MEN

—Starts on page 74

National Constructors Association. Other officers are: vice president, C. D. Haxby, Rust Engineering Co. and secretary-treasurer, C. B. Brunson.

★ Walter E. Blomgren has retired as assistant chief engineer of the Bureau of Reclamation, U. S. Department of the Interior. He is opening a consulting office in Denver specializing in irrigation and drainage development here and abroad.

★ P. L. Griffith is appointed director of industrial development for Walter Kidde Constructors, Inc.



GRIFFITH McCOY

★ Rust Engineering Co. has named C. Dana McCoy as New York manager and international director.

★ The firm of Seelye, Stevenson, Value & Knecht, Consulting Engineers, announces admission to partnership of Gilbert D. Fish, A. Roger Kelly, Erik B. J. Roos, Stephen D. Teetor, and Harold S. Woodward.

★ Franklin C. MacKrell, a vice president of Stone & Webster Engineering Corp., is appointed district manager in charge of the Chicago office. He succeeds Louis H. G. Bouscaren who retired last year.

MacKRELL KULJIAN

★ The Pennsylvania Society of Professional Engineers has nominated Harry A. Kuljian, president of The Kuljian Corp., as "Engineer of 1954." He is cited for outstanding engineering achievements as a consultant, designer, and engineer-builder of world-wide stature.

★ Bert L. Snell is appointed vice president of Luria Construction Corp., construction affiliate of the Luria Engineering Co.

Techniques of Telemetering

—*Starts on page 60*

range of 15 to 35 cps, proportional to the applied millivoltage.

The generated frequency from the transmitter is sent through the transmission channel to a receiver that converts the frequency to millivolts again. Indication or recording at transmitter or receiver locations is accomplished by measurement of the millivolts with a self-balancing electronic potentiometer. Because the frequency-millivolt relationship is linear, one recorder can totalize the readings received from several transmitters.

Another frequency type of telemetering system involves essentially the same component arrangement for similar applications, though it differs in principle. The variable to be measured is translated into an electrical value that is applied to the telemeter transmitter. Incorporated in the transmitter are watt-hour elements linked to a common shaft whose speed of rotation deviates from a common base speed in accordance with the magnitude of the electrical input. Through the use of a notched disc attached to the shaft, plus a light and a photocell, the speed of rotation is converted to a signal whose frequency is proportional to the measured variable. The system operates over a 6- to 27-cps range. Here again, the system is linear and readings of several transmitters can be totalized on one recorder. ▲▲

Electromagnetic Pumps

—*Starts on page 34*

bearings or seals to replace. The only problem is that of corrosion of the pump by the liquid being pumped. While this problem is serious with certain fluids, it is no more serious in the pump than in other sections of the conduit.

It may well be noted that leakage can be eliminated by the use of a canned-rotor pump, which utilizes a motor having the rotor sealed within the pipe. This design eliminates the shaft seal but does not eliminate the bearings. However, it has been found that in some applications, the metal being pumped can serve as the lubricant for the bearings. In event of failure of the rotor of a canned-rotor pump, the casing must be opened for repairs, and this may present serious problems if the fluid being pumped is radioactive.

At present, the principal disadvantage of the electromagnetic pump for the handling of conducting materials is probably its low efficiency. However, studies are being made of methods for improving the efficiency. Power losses in the walls of the conduit are reduced by making the conduit walls thin and utilizing a material of high electrical resistivity when possible. Fringing losses in the magnetic field are being reduced by improvements in design. Baffles can be used within the conduit to improve the field and to reduce eddy currents. In some instances, the efficiency can be improved by altering the aspect ratio (ratio of depth to width) of the conduit at the effective section. Vibration may occur in an a-c electromagnetic pump and cavitation may develop in certain designs. In critical installations these possibilities must be checked and, if possible, eliminated since either one may lead to rupture of the conduit.

Designs are continually being improved as a result of research, the use of more effective materials, and better arrangement of those materials. It is now apparent that the electromagnetic-type pump is taking its place in industry as a unit that for some applications is superior to conventional pumps. ▲▲

BIBLIOGRAPHY

Barnard, John and G. D. Collins, *Test of 1200-gpm Linear A-C Electromagnetic Pump,* AECD-3460, U.S. Atomic Energy Commission.

Cage, J. F., Jr., "Electromagnetic Pumps for High Temperature Liquid Metal," *Mechanical Engineering,* May 195[illegible].

Cage, J. F., Jr. and E. H. Schoch, *Description and Test Results of a 400-gpm Liquid Metal Induction Pump,* AECD-3459, U. S. Atomic Energy Commission.

Collins, G. D. *Operation and Analysis of a 100-psi Electromagnetic Pump,* KAPL-668, U.S. Atomic Energy Commission.

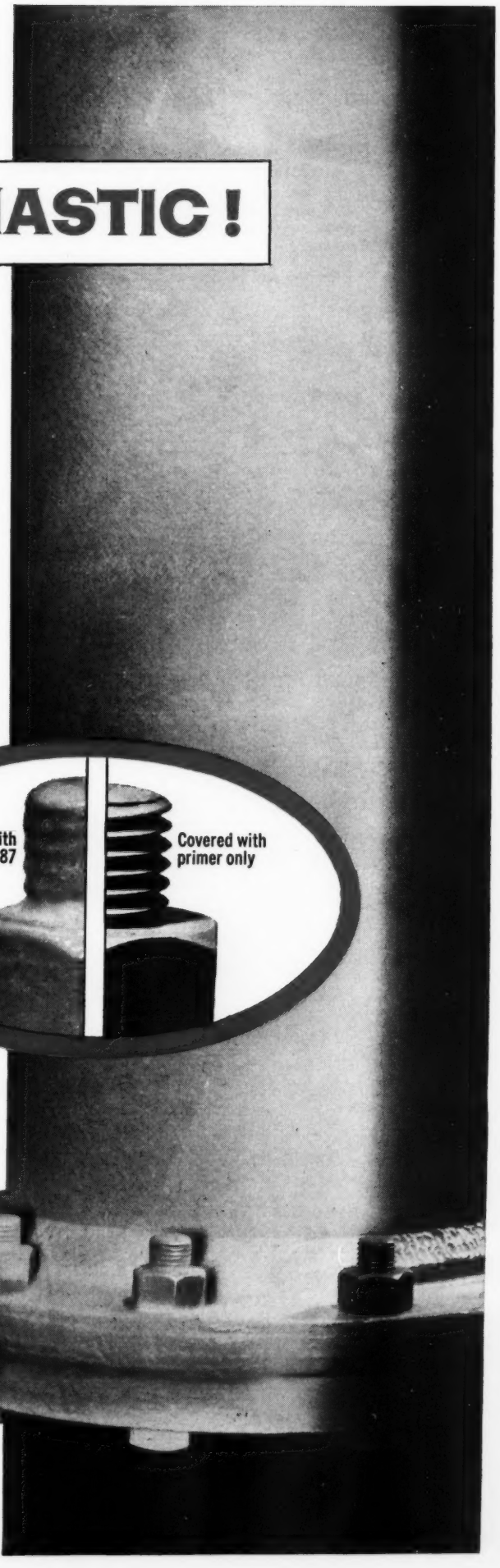
Lyon, R. N. (Editor), *Liquid Metals Handbook,* NAVEXOS P-733, U. S. Atomic Energy Commission and U. S. Dept of the Navy.

Vandenberg, L. B., *Homopolar Generator Pump for Liquid Metals,* AECD-3368, U. S. Atomic Energy Commission.

Watt, D. A., *A-C Liquid Metal Pumps for Laboratory Use,* AERE CE/R 1089, Ministry of Supply, Harwell, England.

At last!

A TRUE VINYL MASTIC!



Complete protection in a single coat—10 mils thick.

Amercoat No. 87 will cut your maintenance costs because one coat gives you the thickness and protection previously available only through the application of multiple coats.

Amercoat No. 87 is the brand new solution to an old problem, for it combines the time-tested chemical and weather resistance of a vinyl with the extra thickness that was heretofore available only in conventional mastics.

Amercoat No. 87 is easily applied with standard industrial spray equipment. Only one cross-spray coat, over a primed surface, is required for complete protection. Because **Amercoat No. 87** is a true vinyl, it is not limited to black, but is available in a variety of colors.

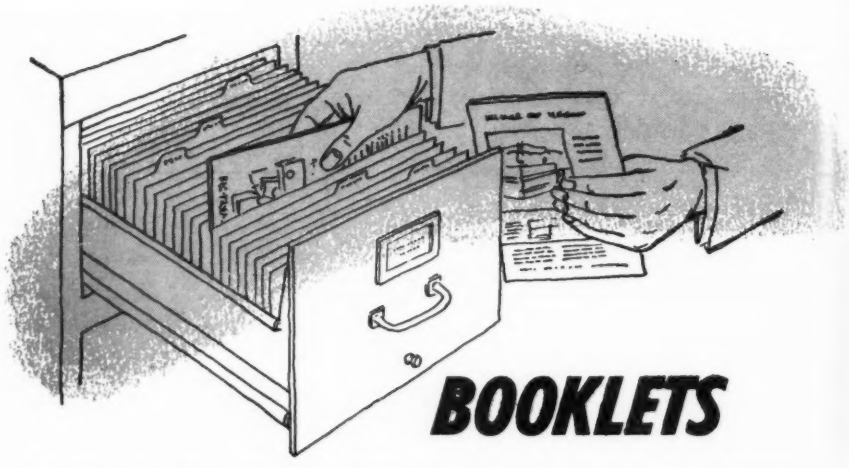
You can save up to 50% of your labor costs with **Amercoat's new vinyl mastic No. 87.** We will be pleased to send you a bulletin describing this new coating in detail.

Notice that the sharp bolt threads, welds and sharp corners are completely protected with one coat of Amercoat No. 87—10 mils thick!

Amercoat CORPORATION

Dept. S,
4809 Firestone Blvd.,
South Gate, California

EVANSTON, ILL. • KENILWORTH, N.J. • JACKSONVILLE, FLA. • HOUSTON, TEX.



BOOKLETS

Personal copies of booklets can be obtained by writing directly to the manufacturers

"SUNTROL GLASS BLOCK FOR REDUCTION OF GLARE AND HEAT," eight-page booklet, shows in detail the physical performance of the glass blocks, illustrating the principle of Suntrol—a pale green diffusing screen that helps to reduce intensity of glare and heat. *Pittsburgh Corning Corp., Dept. CE, One Gateway Center, Pittsburgh 22, Pa.*

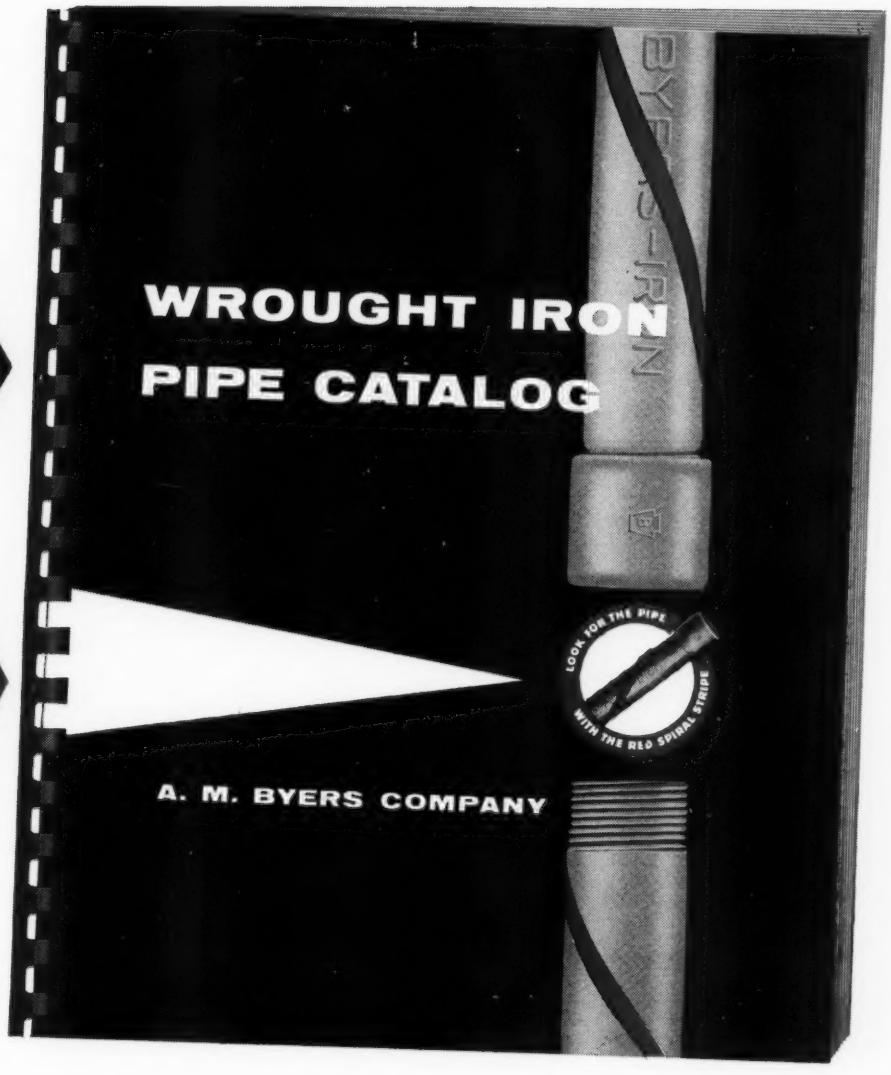
"A-C-D-C EXPANDED SCALE PANEL VOLTMETERS," four-page bulletin 116, describes meters whose scales include only the range of interest; the rest of the scale has been discarded entirely for greater expansion, ease, and accuracy of reading. The booklet includes information on the new 2½ in. panel meter and the whole new line of d-c meters. *Arga Div., Dept. CE, Beckman Instruments, Inc., 22 Pasadena Ave., South Pasadena, Calif.*

THE LATEST COPPER and copper-alloy specifications are listed in tabular form in 24-page reference manual B-34R. The index is divided into two sections: a list of the most

NEW!

WROUGHT IRON PIPE CATALOG

. . . Complete facts and figures



The NEW Byers Wrought Iron Pipe Catalog wraps up between covers complete facts and figures on wrought iron pipe and tubular products.

You'll find:

. . . information on the characteristics of wrought iron and why it resists corrosion and vibration longer

. . . a complete section on wrought iron's physical properties

. . . detailed instructions on how to specify plus a list of wrought iron standards and specifications

. . . proper ordering methods so you get exactly what you want for the job

. . . general notes on mill standards

. . . complete tables on every type of wrought iron pipe, conduit, cold drawn tubing, with detailed data on sizes, dimensions, weights, mill test pressures

. . . helpful tables on decimal equivalents for calculating; dimensions of pipe in fractions of an inch; conversion factors

Important, too, is the organization and arrangement of this material. The catalog's format makes charts and tables easy to find, easy to read and follow. You'll like the way the plastic spiral binding keeps the catalog flat while you use it . . . important with a 52 page catalog.

Your copy is ready. Write for it today!

A. M. Byers Company, Pittsburgh, Pa. Established 1864. Boston, New York, Philadelphia, Washington, Atlanta, Chicago, St. Louis, Houston, San Francisco. Export Department: New York, N.Y.

Available throughout the world.

BYERS

CORROSION COSTS YOU MORE THAN WROUGHT IRON

WROUGHT IRON

TUBULAR AND HOT ROLLED PRODUCTS

ELECTRIC FURNACE QUALITY STEEL PRODUCTS

BOOKLETS —*Starts on page 80*

generally used alloys with applicable specifications of the various national engineering societies and government agencies; and a list of specifications in numeric order with a brief description of the material. *The American Brass Co., Dept. CE, Waterbury 20, Conn.*

"VERTICAL INDUSTRIAL SERVICE PUMPS," 15-page bulletin B-505, describes three basic pump production designs: standard service type and heavy duty service type, both of which can be applied to pumping of clear water and alkaline liquids; and the special service type for pumping hydrocarbons and other process liquids. *Peerless Pump Div., Food Machinery and Chemical Corp., Dept. CE, 310 W. Ave. 26, Los Angeles 31.*

ANNUAL LISTING OF PUBLICATIONS from the Massachusetts Institute of Technology includes titles of periodical publications, book reviews, and technical reports written by members of the MIT faculty and staff during the year ending July 1, 1954. The 80-page booklet also contains a complete index of authors of all titles. *Office of Publications, Room 7-204, Dept. CE, Massachusetts Institute of Technology, Cambridge 39, Mass.; 50¢ each.*

UTILITY BLOWERS — Dimensions, specifications, and performance data on the non-overloading utility blowers with backward curved blades are presented in easy-to-use form in 47-page bulletin BC-11. *Hartzell Propeller Fan Co., Dept. CE, Piqua, Ohio.*

WHITEPRINTERS — Four-page bulletin 65S2 tells how the compact P&H SpeedMaster ammonia-dry and moist-process whiteprinters provide maximum efficiency in minimum space, make it easy to print and develop exact copy black-line and colored-line whiteprints in volume as needed. *P&H Sales Corp., Dept. CE, 5640 N. Western Ave., Chicago 45.*

"MODELS FOR PRODUCTION LINES," four-page folder, points out the advantages of using layout models and explains how this company has been able to produce models for half the price usually considered standard. It explains how to get a model estimate and how to reproduce model arrangements on blueprints. *Industrial Models, Inc., Dept. CE, 2311 Sconset Rd., Wilmington 3, Del.*

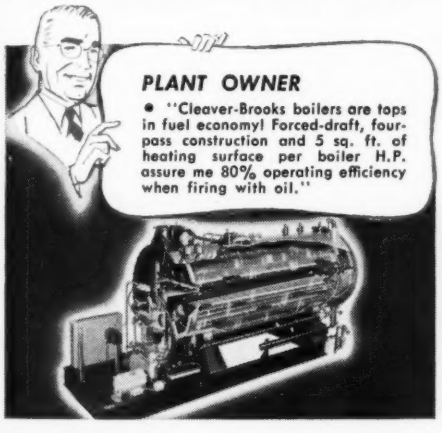
"CHECK THE FACTS," 12-page booklet B-2401, points out 100 characteristic facts of the new line of Reliance totally-protected a-c motors. Included is a classification of significant points common to all Reliance a-c motors with a further breakdown of information specifically pertaining to the protected and enclosed motors. *Reliance Electric & Engineering Co., 1088 Ivanhoe Rd., Dept. CE, Cleveland 10, Ohio.*

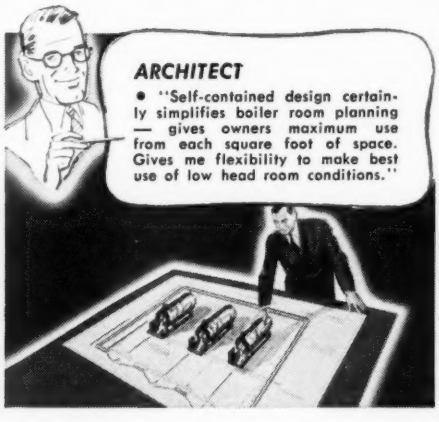
TESTING EQUIPMENT — A full line of apparatus for engineering tests of soils, concrete, asphalt, and construction materials is presented in 104-page catalog 55. Included are suggested laboratory layouts with equipment lists for soils, concrete, and asphalt laboratories. *Soiltest, Inc., Dept. CE, 4520 W. North Ave., Chicago 39, Ill.*

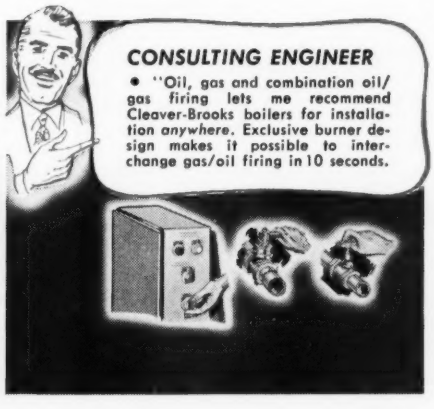
"WROUGHT IRON FOR HIGHWAY CONSTRUCTION," eight-page booklet, is designed to help highway officials and engineers select materials for use in corrosive highway services. Photographs show road and bridge

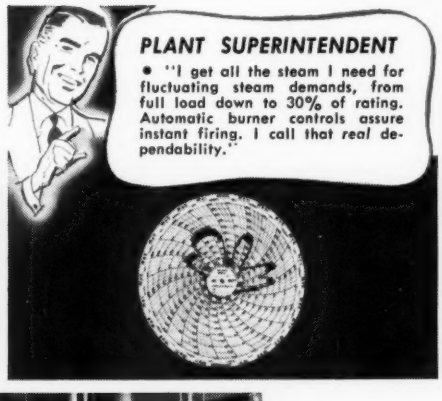
CLEAVER-BROOKS SELF-CONTAINED BOILERS HAVE THE FEATURES EVERYONE WANTS!

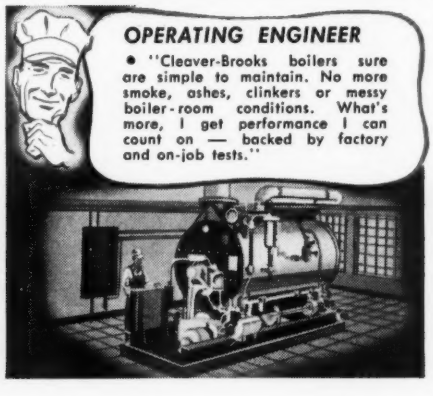
...which feature would be most important to you?

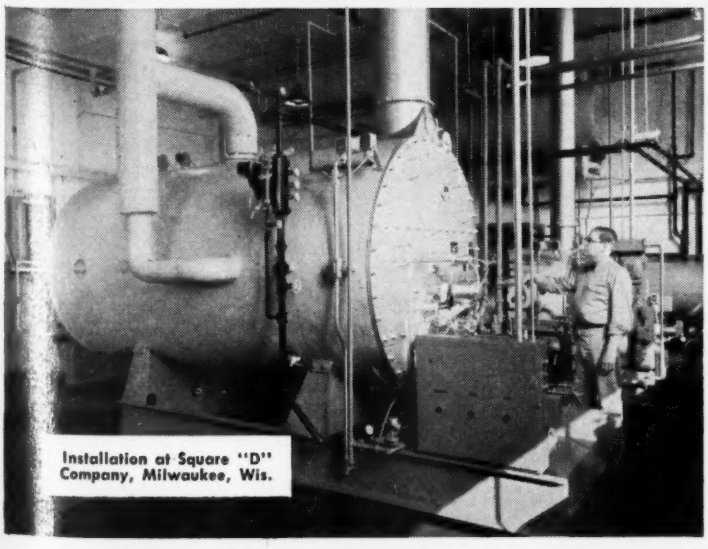











Installation at Square "D" Company, Milwaukee, Wis.

THESE are just a few of the many outstanding features that have made more than 15,000 individual Cleaver-Brooks self-contained boilers *first choice* for commercial, institutional and industrial applications. Get in touch with your nearest Cleaver-Brooks representative for complete facts, or write for catalog AD-100. Cleaver-Brooks Co., Dept. B, 321 E. Keefe Ave., Milwaukee 12, Wis., U.S.A. — *Cable address: CLEBRO — Milwaukee — all codes.*

Cleaver Brooks

"It's NEW — get the facts on the CB boiler — write today!"

BOILERS — STEAM OR HOT WATER — FOR HEATING OR PROCESSING IN SIZES FROM 15 TO 500 HP, 15 TO 250 PSI.

NOW — FIRST SIZES OF THE CB BOILER ARE MADE IN CANADA, TOO.

BOOKLETS —*Starts on page 80*

applications in which wrought iron pipe and plate are presently serving. *A. M. Byers Co., Dept. CE, Clark Bldg., Pittsburgh, Pa.*

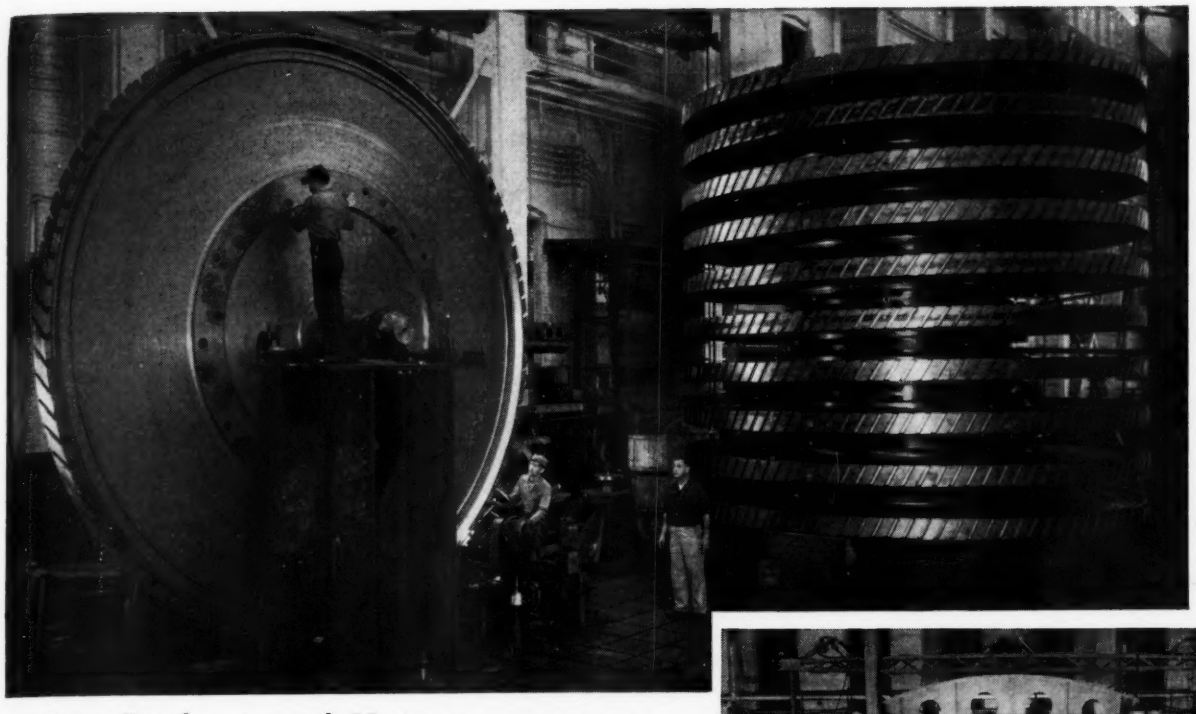
"TAYLOR FORGE FOUNDATION PIPE," eight-page bulletin 542, describes characteristics of this pipe used for piling and illustrates its application in construction of bridges and buildings. Sizes of pipe commonly used for piling are listed and driving ends preparation are shown. *Taylor Forge & Pipe Works, Inc., Dept. CE, P. O. Box 485, Chicago 90, Ill.*

ALUMINUM—The answer to builders' demands for more attractive, modern-looking, low-cost industrial building products is described in revised booklet, "Alcoa Aluminum Industrial Building Products." Industrial roofing and siding, industrial flat flashing stock, fasteners, and preformed accessories are included. *Aluminum Company of America, Dept. CE, 753 Alcoa Bldg., Pittsburgh 19, Pa.*

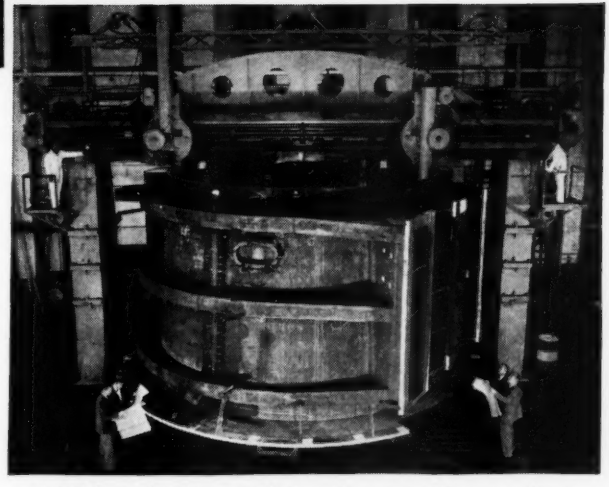
FUEL COST CALCULATOR — Handy pocket-size "slide-rule" calculator shows comparative fuel cost of coal, gas, and oil. It is designed so that you can determine fuel savings when replacing present heating equipment with a Hev-E-Oil burner. *Cleaver-Brooks Co., Hev-E-Oil Burner Div., Dept. CE, 326 E. Keefe Ave., Milw., Wis.: 25¢.*

"GAGE GLASS TO TV TUBE," a reprint from CONSULTING ENGINEER, written by R. E. Derby and Frank Ptacek gives the history of boiler water level gages, suggests types to use for specific applications, and looks into possible future developments. *Yarnall-Waring Co., Dept. CE, Mermaid Lane, Philadelphia 18.*

THE NEW KODASCOPE PAGEANT series of 16mm sound and silent projectors and their many possible uses under varying conditions of audio-visual operation are presented in six-page foldout EV3-22. The wide range of models makes possible selection by business and industry of equipment tailored to almost any requirement. *Eastman Kodak Co., Dept. CE, 2, Rochester 4, N. Y.*



Rotor discs for mammoth 11-stage compressor were balanced and stacked for alignment in one of Newport News' five huge machine shops. Large engineering and technical staffs with a vast plant make Newport News an ideal source for large equipment . . . *standard or special in design.*



A 35-foot boring mill in Newport News' plant machining the 374,000-pound upstream housing for the giant axial flow compressor. The compressor is heart of an 8-foot supersonic wind tunnel at the Ames Aeronautical Laboratory of the National Advisory Committee for Aeronautics at Moffett Field, Calif.

To create winds exceeding

2000 MPH

Newport News builds world's Mightiest Compressor

Whenever you want large units built with careful attention to detail, give the job to Newport News.

This company recently built an eleven-stage axial flow compressor that shatters all previous records for wind force . . . using what is believed to be the world's largest rotating object.

The rotor, weighing more than 400 tons, comprises eleven huge discs. Each disc, machined from a 93,000-pound forging, was finished to a 50,000-pound wheel and balanced to within 26 ounces at the rim. In each rim, slots for blades were machined to within .005" on special milling heads designed and produced in the Newport News plant.

Here at Newport News, you'll find more than large productive capacity. In machine shops, foundries and forging plants Newport News craftsmen complete your orders with specialized techniques backed by experience in fabricating thousands of products.

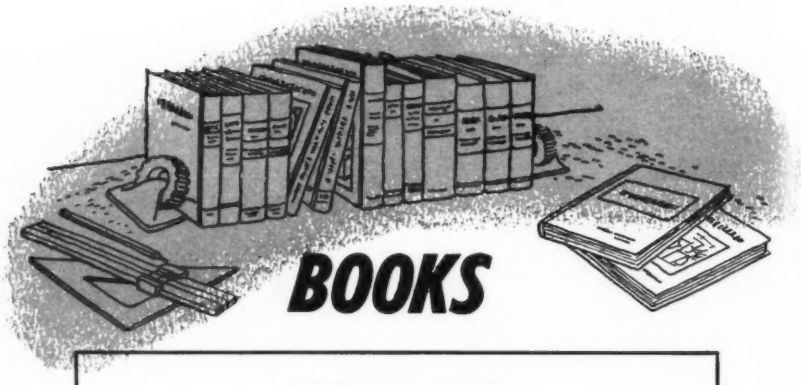
Newport News' craftsmen produce units that range from small components of spinning machines, to mammoth hydraulic turbines . . . from piping, pumps and valves, to vacuum tanks, digesters and bridge caissons.

These skilled men handle the job exactly as you want it done, for maximum results per dollar invested. So let us bid on your present or future projects. Learn how Newport News can help you. Send for our illustrated booklet entitled, "Facilities and products" . . . it's your for the asking.

Newport News

Shipbuilding and Dry Dock Company

Newport News, Virginia



TO ORDER BOOKS

As a readers' service, CONSULTING ENGINEER will order reviewed books or any other technical volumes you need. In ordering books, give title, author, and publisher and enclose check. We will also suggest titles of books on any technical subject and order for you at regular publishers' prices.

DETERIORATION OF MATERIALS: CAUSES AND PREVENTIVE TECHNIQUES, edited by Glenn A. Greathouse and Carl J. Wessel; Reinhold Publishing Corporation; 835 pp; $12.00.

Reviewed by Dr. Thomas D. Parks
Stanford Research Institute

This book is a significant contribution to the study of the deterioration of materials. The volume represents the contributions of 24 experts in several fields of study. Deterioration in relation to climate, chemical and physical agents, and biological agents is covered in three well-written chapters comprising Part I. Part II devotes a chapter each to metals, wood, paper, textiles and cordage, leather, plastics and rubber, and paints, varnishes, enamels, and lacquers. These chapters, in particular, are well documented with tabular data and with photographs of materials undergoing deterioration.

Part III devotes a chapter each to electrical and electronic equipment, and to optical and photographic equipment. Emphasis in these chapters is on equipment for military applications. Much of the data are drawn from experiences of the armed services in the Pacific during World War II. Part IV deals with dehumidification, packaging, and toxicological evaluation of preservatives. In addition, there is an appendix, "Sources and Identifying Symbols of Government Specifications," which should be valuable to anyone who is concerned with supplying materials to the armed services or other branches of the government.

The book is attractively printed and bound, well organized, and thoroughly documented. This book should be useful as a standard reference for many years to come.

•

ELECTRIC TRANSMISSION AND DISTRIBUTION, edited by B. G. A. Skrotzki; McGraw-Hill Book Co.; 448 pp; $7.50.

Reviewed by H. Carl Bauman
Chemical Construction Corporation

Except for the introductory chapter, which is devoted to a review of fundamentals, this book is largely descriptive of modern techniques and equipment. An early chapter by Francis B. Benson, Pacific Gas and Electric Company, is devoted to the physical arrangements of bus structures, switchgear, switching systems and substations — including detailed descriptions of such equipment as insulators, circuit breakers, air switches, and control panels.

In another chapter, Benson explains components of transmission lines — describing construction features and uses of cable, insulators, steel and wood supporting towers, and lightning protection devices. Several pages are devoted to descriptions and illustrations of facilities for underground transmission via insulated cable in concrete ducts and manhole arrangements.

In a similar vein, E. M. Adkins, Jersey Central Power and Light Company, describes features of typical underground and overhead distribution structures, equipment and devices. A brief qualitative analysis of the reasons for a choice between overhead and underground distribu-

tion is presented. Adkins presents an analysis of pole line stresses and illustrates how to design for various line angles, and for conductor and wind loadings. This is supplemented with suitable pole strength and conductor tables for use in calculating line and tension values.

E. L. Michelson, Commonwealth Edison Company, wrote the concluding chapter, describing such system auxiliaries as ac-dc converters, synchronous condensers and capacitors for power factor correction, rectifier substations, and voltage regulators and feeder reactors for short-circuit limitation.

A minimum of mathematics is used in the book. Mathematics, where applied, are elementary and should be readily followed by readers having no more than a knowledge of algebra and trigonometry.

This book should serve as a useful tool for non-electrical consulting engineers who must have some knowledge of this highly specialized field. The text is well illustrated with photographs of equipment, simple vector diagrams, drawings, suitable tables, curves, and charts.

ALSO AVAILABLE

HIGHWAY ENGINEERING, by Laurence I. Hewes and Clarkson H. Oglesby; John Wiley & Sons; 628 pp; $8.00.

Covering both engineering design and construction practices, the book is weighted toward design. In the light of modern trends, the authors have given greater than usual attention to the questions of highway economy and finance, rights of way, drainage, and traffic engineering. The chapters on soils, bases, and pavements concentrate primarily on design techniques and the research findings that affect them.

•

FEDERAL PUBLICATIONS of interest to many consulting engineers are available directly from the Superintendent of Documents, Washington 25, D. C. Among recently announced titles are these: *Airport Terminal Buildings*, No. C 31.102: T 27/2, 42 pp, 25¢; *City To Airport Highways*, No. C 31.102: H 53, 22 pp, 20¢; *Standard Specifications for Construction of Airports*, No. C 31.120: Ai 7, 588 pp, $3.00; *Criteria for Prestressed Concrete Bridges*, No. C 37.2: B76/3, 25 pp, 15¢; and *A Guide for Contracting of Construction and Related Engineering Services, Atomic Energy Commission*, No. Y 3.At 7:2 C 76/2/952, 15 pp, 15¢. ▲▲

consulting engineer

ADVERTISERS' INDEX